



# Bicycle & Pedestrian Master Plan

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Prepared by

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# acknowledgements

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In association with:



chapter one

# introduction

Bicycling and walking are increasingly recognized as an important component of the transportation system. The Saratoga Springs Bicycle and Pedestrian Master Plan (the Plan) sets forth a vision and goals and policies for walking and bicycling in Saratoga Springs:

*“Saratoga Springs will create healthy and vibrant communities through the creation of attractive and safe bicycle and pedestrian networks that can be enjoyed for recreation and transportation.”*

The Plan serves as a guide for elected officials, City staff, and Saratoga Springs residents to implement infrastructure necessary to achieve the Plan’s vision. The Saratoga Springs Bicycle and Pedestrian Master Plan does this by proposing a system of bikeways, sidewalks, and trails connecting neighborhoods to key activity centers throughout the City, developing support facilities, and by identifying recommendations for monitoring the implementation of the Plan.

## Bicycle and Pedestrian Master Plan Overview

This is Saratoga Spring’s first ever Bicycle and Pedestrian Master Plan. Previously, all bicycle planning and policy was contained within the City’s General Plan or in the Trails Master Plan.

The development of the Plan comes as part of an effort by the City to address local and regional desires to enhance the viability of active transportation as mode of transportations, enhance the local quality of life, and reduce transportation system impacts on local communities.

The goals, policies, and recommendations in this Plan are the of a public outreach effort by the Project Team. Between June and December 2015, the City and consultant team accepted public input to the Plan at one public event and through an on-line survey and on-line web application. Additionally, a public website and Facebook broadcasted the latest news related to the Plan.

## Making the Case for Investment

Walking and bicycling are effective ways for people to improve their health and wellbeing. But the benefits of active transportation go beyond the health of the individual. A growing body of research shows that active transportation can also benefit the environment and improve the transportation network. The addition of active transportation infrastructure can even boost economic viability in the places where it is located. A short summary of research regarding the benefits of active transportation infrastructure is provided below.

## Air Quality

- Research indicates that transportation accounts for roughly 28 percent of the United States' total greenhouse gas (GHG) emissions<sup>1</sup>. Of commuting modes, automobiles have the largest impact on air quality<sup>2</sup>. Bicycling and walking have a negligible GHG impact (outside of the production needed in the manufacturing of the bicycle).
- The Rails To Trails Conservancy estimates that bicycling and pedestrian travel can offset between 3 percent and 8 percent of GHG emissions in the United States caused by surface transportation<sup>3</sup>.
- Many state applications for Congestion Mitigation and Air Quality Improvement Program (CMAQ), a federal funding program, ask applicants to estimate the congestion and GHG reduction potential of their bicycle and pedestrian projects. A federal review of CMAQ bicycle and pedestrian projects found CO<sub>2</sub> reductions of up to 38.4 kg emissions reductions each day<sup>4</sup>.

### MAKING THE CASE

According to research conducted in the Portland area, every 1% increase in miles traveled by active transportation instead of by car reduces regional greenhouse gas emissions by 0.4%.

## Reduced Vehicle Miles Traveled

- Many trips regularly done by car can be done by bicycle. The national average trip length is 2.25 miles for a one-way bicycling trip. Half of all trips taken in the United States are three miles or less, with 40 percent under two miles. However, 90 percent of trips fewer than three miles are taken by car<sup>5</sup>.
- A study in King County, Seattle, WA found that a 5 percent increase in walkability of a community reduced vehicle miles traveled per capita by 6.5 percent and increased time spent in physically active travel by 32.1 percent<sup>6</sup>.

<sup>1</sup> Moving Cooler Steering Committee. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions*. Prepared by Cambridge Systematics, Inc. July 2009.

<sup>2</sup> Urban Transportation Caucus. *Urban Transportation Report Card*. August 2007. Accessed online June 2013: [http://www.transalt.org/files/newsroom/reports/Urban\\_Transpo\\_Report\\_Card.pdf](http://www.transalt.org/files/newsroom/reports/Urban_Transpo_Report_Card.pdf)

<sup>3</sup> Oregon Metro. *The Case for Active Transportation*. Spring 2009. Accessed online June 2013: [http://library.oregonmetro.gov/files//case\\_for\\_at.pdf](http://library.oregonmetro.gov/files//case_for_at.pdf)

<sup>4</sup> Ibid.

<sup>5</sup> America Bikes and the League of American Bicyclists. *National Household Travel Survey – Short Trips Analysis*. Accessed online June 2013: <http://www.bikeleague.org/content/national-household-travel-survey-short-trips-analysis>

<sup>6</sup> Frank, L. D., J. F. Sallis, T. L. Conway, J. E. Chapman, B. E. Saelens and W. Bachman (2006). "Many Pathways from Land Use to Health: Associations between Neighborhood Walkability and Active Transportation, Body Mass Index, and Air Quality." *Journal of the American Planning Association* 72(1): 75-87

## Increased Bike Commuting

- Each additional mile of bicycle lane per square mile is correlated with an approximate one percent increase in the share of bike-to-work trips<sup>7</sup>.
- Cities with higher levels of bicycle infrastructure (lanes and paths) also saw higher levels of bicycle commuting<sup>8</sup>.
- The construction of a bicycle and pedestrian bridge in Charleston, South Carolina led to more cycling throughout the City. A survey conducted on trail use showed that 67 percent of users claimed their physical activity had increased since the path opened<sup>9</sup>.

### MAKING THE CASE

An analysis of Portland, Oregon's bicycle infrastructure on health savings shows that completion of their 2030 Plan would help the City save \$800 million due to fuel cost savings, health care savings, and the value of reduced mortality.

## Health Benefits

- Communities with higher rates of bicycling and walking have lower obesity rates than communities with lower levels of active transportation<sup>10</sup>.
- Researchers from Harvard University found that bicycling for as little as five minutes each day can prevent weight gain for middle aged women<sup>11</sup>.
- The National Institutes of Health have shown that people are more likely to consistently ride a bicycle or walk than to maintain a gym-based exercise program<sup>12</sup>.
- Commuters using active transportation modes are happier with their commutes<sup>13</sup>.
- People who use active transportation to commute report fewer days of work missed due to illness than those with non-active commutes<sup>14</sup>.

<sup>7</sup> Dill, Jennifer and Carr, Theresa. "Bicycle Commuting and Facilities in Major U.S. Cities: If you build them they will come – another look." Accessed online June 2013: [http://www.des.ucdavis.edu/faculty/handy/ESP178/Dill\\_bike\\_facilities.pdf](http://www.des.ucdavis.edu/faculty/handy/ESP178/Dill_bike_facilities.pdf).

<sup>8</sup> Dill, Jennifer and Theresa Carr. (2003). Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them They Will Come – Another Look Transportation Review Board 2003 Annual Meeting. [http://www.des.ucdavis.edu/faculty/handy/ESP178/Dill\\_bike\\_facilities.pdf](http://www.des.ucdavis.edu/faculty/handy/ESP178/Dill_bike_facilities.pdf)

<sup>9</sup> "Wonder's Way Bike Pedestrian Pathway on the Arthur Ravenel, Jr. Bridge: A Successful Model for Facilitating Active Living in Lowcountry South Carolina" ([http://media.charleston.net/2009/pdf/crbpathstudy\\_032609.pdf](http://media.charleston.net/2009/pdf/crbpathstudy_032609.pdf)).

<sup>10</sup> "Walking and Cycling to Health: A Comparison of Recent Evidence from City, State, and International Studies" (<http://www.cfah.org/hbns/archives/viewSupportDoc.cfm?supportingDocID=943>).

<sup>11</sup> "Bicycle Riding, Walking, and Weight Gain in Premenopausal Women" (<http://archinte.ama-assn.org/cgi/reprint/170/12/1050>).

<sup>12</sup> "Randomised controlled trials of physical activity promotion in free living populations: a review" (<http://www.ncbi.nlm.nih.gov/pubmed/7499985>).

<sup>13</sup> "Like commuting? Workers' perceptions of their daily commute" (<http://www.statcan.gc.ca/pub/11-008-x/2006004/pdf/9516-eng.pdf>).

<sup>14</sup> "Physical activity, absenteeism and productivity: an Evidence Review" (<http://www.tfl.gov.uk/assets/downloads/businessandpartners/Physical-activityabsenteeism-and-productivity-evidence-review.pdf>).

- A study by the National Institutes of Health determined that physically active employees incurred approximately \$250 less in health care costs annually compared to sedentary employees<sup>15</sup>.

## Transportation Safety

- There is safety in numbers. The walking/bicycling crash risk decreases as walking/bicycling rates increase<sup>16</sup>.
- The National Institutes of Health found that for every 100 percent increase in the number of cyclists, the number of fatalities only increases by 25 percent, thus reducing the overall risk of cycling by 37 percent<sup>17</sup>.
- The presence of bike lanes have been shown to reduce the overall crash rate by 18 percent compared to streets without any bicycle facility<sup>18</sup>.

## Economic Benefits

- The combined potential value of bicycling in Wisconsin totals nearly \$2 billion yearly<sup>19</sup>.
- It's been estimated that the entire bikeway network of Portland, Oregon was built for less than the cost of constructing one mile of urban freeway<sup>20</sup>.
- There is a 12.5 percent increase in productivity of employees who exercise as compared to those who do not exercise<sup>21</sup>.
- A survey of residents along bicycle boulevards indicated that the majority of respondents felt that bicycle boulevards have had a positive impact on home values, quality of life and sense of community, along with reducing noise, improving air quality, and providing convenience for bicyclists. Additionally, 42 percent of respondents said living on a bicycle boulevard makes them more likely to bike<sup>22</sup>.
- Installation of bike lanes and bike racks can have a positive influence on the local economy. Fort Worth, Texas spent \$12,000 to purchase 80 bike racks and \$160,000 on local road diets in one district in town. As a result, local restaurants experienced a 200 percent increase in business<sup>23</sup>.

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<sup>15</sup> "Relationship of body mass index and physical activity to health care costs among employees" (<http://www.ncbi.nlm.nih.gov/pubmed/15167389>).

<sup>16</sup> Source: "Safety in numbers: more walkers and bicyclists, safer walking and bicycling" (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1731007/pdf/v009p00205.pdf>).

<sup>17</sup> Source: "An expert judgment model applied to estimating the safety effect of a bicycle facility" (<http://www.ncbi.nlm.nih.gov/pubmed/10868762>).

<sup>18</sup> "Adult Bicyclists in the United States: Characteristics and Riding Experience in 1996" (<http://www.enhancements.org/download/trb/1636-001.PDF>).

<sup>19</sup> Gabrow, Maggie, Micah Hahn, Melissa Whited. (2010). Valuing Bicycling's Economic and Health Impacts in Wisconsin. The Nelson Institute for Environmental Studies and the The Center for Sustainability and the Global Environment. University of Wisconsin-Madison. Prepared for Representative Spencer Black.

<sup>20</sup> <http://www.politifact.com/oregon/statements/2011/mar/19/samadams/>

[portland-mayor-sam-adams-says-portlands-spent-its-/](http://www.portlandmayor.com/news/2011/03/19/portland-mayor-sam-adams-says-portlands-spent-its-/)

<sup>21</sup> Campbell, Richard and Wittgens, Margaret. (2004). The Business Case for Active Transportation: The Economic Benefits of Walking and Cycling. Prepared for Better Environmentally Sound Transportation.

<sup>22</sup> VanZerr, Mariah. (2009). Resident Perceptions of Bicycle Boulevards: A Portland, Oregon Case Study. Submitted to the Transportation Research Board for the 89th Annual Meeting.

<sup>23</sup> Elly Blue's Bikenomics series: <http://grist.org/biking/2011-04-11-the-economic-case-for-on-street-bike-parking/>

## Impacts on Home Values

- The walkability of an area can directly impact home values. Homes with above average levels of walkability are worth \$4,000 to \$34,000 more than homes with average levels of walkability in the areas studied. Typically, a one point increase in Walk Score was associated with between a \$500 and \$3,000 increase in home value<sup>24</sup>.
- The Urban Land Institute compared four new pedestrian communities to determine the effect of walkability on home prices. They determined that homebuyers were willing to pay \$20,000 more for homes in walkable areas compared to similar homes in surrounding areas<sup>25</sup>.
- For developers, walkability translates into direct economic benefits. In Washington, buildings in neighborhoods with good walkability command an average of \$8.88/sq. ft. per year more in office rents and \$6.92/sq. ft. per year higher in retail rents, and generate 80 percent more in retail sales as compared to places with fair walkability, holding household income levels constant. Housing prices and property values are also increased in areas with higher walkability – a place with good walkability, on average, commands \$301.76 per month more in residential rent and has for-sale residential property values of \$81.54/sq. ft. more relative to places with fair walkability, holding household income levels constant<sup>26</sup>.
- Adjacency to trails can also have a positive effect on property values. For instance, according to the Rails to Trails Conservancy, lots adjacent to Wisconsin’s Mountain Bay Trail sold for 9 percent more than similar properties not adjacent to the trail<sup>27</sup>.
- In Apex, North Carolina, houses adjacent to a regional greenway sold for \$5,000 more than houses in the same subdivision that were not on the greenway<sup>28</sup>.

## Job Creation

- A national study of employment impacts following the installation of bicycle and pedestrian infrastructure estimated that each \$1 million in bicycle-related projects creates 11.4 jobs from direct, indirect and induced construction spending. Likewise, pedestrian-only projects create about 10 jobs and multi-use path projects create 9.6 jobs per \$1 million of project cost. Street Projects that combine pedestrian and bicycle facilities with other road improvements create 7.8 jobs per \$1 million. In contrast, road-only projects generated 7.75 jobs per \$1

### MAKING THE CASE

Bike lanes reduced the risk of fatalities in pedestrian-involved crashes by 40%.  
(Source: The New York City Pedestrian Safety Study and Action Plan)

<sup>24</sup> CEOS for Cities. *Walking the Walk*. August 2009. Accessed online June 2013: [http://blog.walkscore.com/wp-content/uploads/2009/08/WalkingTheWalk\\_CEOsforCities.pdf](http://blog.walkscore.com/wp-content/uploads/2009/08/WalkingTheWalk_CEOsforCities.pdf)

<sup>25</sup> Eppli, Mark J. and Charles C. Tu. Valuing the new Urbanism, The Impact of the New Urbanism of Prices of Single-Family Homes. Urban Land Institute, 1999.

<sup>26</sup> Leinberger, Christopher B. and Mariela Alfonzo. (2012). Walk this Way: The Economic Promise of Walkable Places in Metropolitan Washington, D.C. The Metropolitan Policy Program at the Brookings Institute.

<sup>27</sup> Rails to Trails Conservancy. *Economic Benefits of Trails and Greenways*. Washington, DC.

<sup>28</sup> Ibid.

million. Spillover (indirect) employment adds an additional 3 jobs per \$1 million<sup>29</sup>.

- In Colorado, the bicycling industry has created 513 manufacturing jobs and 700 full-time equivalent retail jobs<sup>30</sup>.
- Similar results have been shown in Wisconsin, where the bicycling industry (consisting of manufacturing, distribution, retail, and other services) contributes \$556 million and 3,418 jobs to the Wisconsin economy<sup>31</sup>.
- Portland's bicycle industry has also contributed significantly to the local economy. In 2008, revenues in the bicycle-related economic sector were found to be nearly \$90 million<sup>32</sup>.

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<sup>29</sup> Garrett-Peltier, Heidi (2011). Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts. Political Economy Research Institute. University of Massachusetts, Amherst. <http://www.peri.umass.edu/236/hash/64a34bab6a183a2fc06fdc212875a3ad/publication/467/>

<sup>30</sup> "Economic Impact of Bicycling in Colorado" (<http://atfiles.org/files/pdf/CObikeEcon.pdf>).

<sup>31</sup> Source: "The Economic Impact of Bicycling in Wisconsin" (<http://www.dot.wisconsin.gov/business/econdev/docs/impact-bicycling.pdf>).

<sup>32</sup> "The Value of the Bicycle-Related Industry in Portland" ([http://www.altaplanning.com/App\\_Content/files/fp\\_docs/2008%20Portland%20Bicycle-Related%20Economy%20Report.pdf](http://www.altaplanning.com/App_Content/files/fp_docs/2008%20Portland%20Bicycle-Related%20Economy%20Report.pdf)).

## chapter two

# goals, objectives, and policies

This chapter articulates the purpose, goals and objectives for the Saratoga Springs Bicycle and Pedestrian Master Plan. These principles provide a guiding document for Saratoga Springs in creating, maintaining, and promoting pedestrian and bicycle infrastructure and programs both now and in the future.

## Vision

The vision statement guides Saratoga Springs' direction for bicycle and pedestrian facilities, and provides clear direction for the project. To create consistency with neighboring communities, the Steering Committee reviewed language from previously developed local bicycle and pedestrian master plans, including the Lindon Bicycle and Pedestrian Master Plan (2014), American Fork Bicycle and Pedestrian Master Plan (2013), the Lehi Bicycle and Pedestrian Master Plan, the Pleasant Grove Master Plan (2013), and the Orem Bicycle and Pedestrian Master Plan (2010), as well as national examples from Anchorage, Alaska; Davis, California; Minneapolis, Minnesota; and Portland, Oregon. The vision statement of the Saratoga Springs Bicycle and Pedestrian Plan is:

*“Saratoga Springs will create healthy and vibrant communities through the creation of attractive and safe bicycle and pedestrian networks that can be enjoyed for recreation and transportation.”*

## Goals and Objectives

**Goal 1:** Provide a continuous system of bike lanes, sidewalks, crosswalks, shared paths, and other bicycle and pedestrian facilities throughout Saratoga Springs and connections to neighboring cities that are safe and attractive to all users.

**Objective 1a:** Coordinate multi-modal bicycle and pedestrian planning with adjacent municipalities, including hard surface / paved trails, sidewalks, bike lanes, and soft trails for mountain biking and equestrian use.

**Objective 1b:** Install signage along local and regional bikeways to assist with way-finding and to increase awareness of bicyclists.

**Objective 1c:** Coordinate with the Utah Department of Transportation (UDOT) on desired improvements on State roadways.

**Objective 1d:** Encourage, incentivize, or require new development to participate in the advancement of a robust bicycle and pedestrian system.

**Objective 1e:** Coordinate with Utah County on its Adopt-a-Trail program for shared use paths.

**Objective 1f:** Foster a bicycle friendly atmosphere to attract large events like the Tour of Utah and triathlons.

**Goal 2:** Increase transportation safety for all modes through education and enforcement efforts.

**Objective 2a:** Publish, distribute, and post city and region-wide bike maps.

**Objective 2b:** Keep non-motorized facilities clean, safe, and accessible.

**Objective 2c:** Promote pedestrian and bicycle safety and awareness through education and encouragement activities.

**Objective 2d:** Enhance Safe Routes to School programming and support Saratoga Springs school children who walk and bike to school.

**Goal 3:** Institutionalize bicycle and pedestrian planning and routine accommodation of bicycle and pedestrian needs into city processes.

**Objective 3a:** Involve the Civic Events Committee to attract large events or festivals like the Tour of Utah and triathlons.

**Objective 3b:** Ensure that bicycle and pedestrian facilities are an integral part of intersection and street design.

**Objective 3c:** Standardize bike route detour protocol for roadway construction projects.

**Objective 3d:** Incorporate bicycle and pedestrian network repair and maintenance needs into the regular roadway maintenance regime as appropriate, paying particular attention to sweeping and pothole repair on priority bicycle facilities.

**Objective 3e:** Identify, track, and pursue a variety of funding sources to implement, renovate, and maintain Saratoga Springs' bicycle and pedestrian system.

## chapter three

# existing conditions

### Study Area Context

Saratoga Springs is located in north-central Utah County, neighboring Camp Williams to the north, Lehi to north/east, Eagle Mountain to the west, and unincorporated Utah County to the south. The City is constrained by Utah Lake to the east and Lake Mountain to the west. These constraints and neighboring jurisdictional boundaries make Saratoga Springs a city that runs primarily north to south. At the widest point the City is only approximately five miles wide, and far narrower in other areas.

According to the most recent census estimate available (2014), the city's population is approximately 24,000 and is one of the fastest growing cities in the state – a trend that is expected to continue. The Mountainland Association of Governments (MAG) projects the population to reach 33,500 by 2020 and 58,500 by 2030. According to the city's general plan the estimated buildout population will range between 75,000 and 125,000 people.

The average high temperature for Saratoga Springs in January is 37°F and the average low is 17°F with 1.02 inches of precipitation. In July, the average high temperature is 91°F and the average low is 56°F, with 0.59 inches of precipitation.

Elevation increases from the low points of Utah Lake and the Jordan River to Lake Mountain on the west and the Traverse Mountains to the north create a mixed topography. There is an elevation change of approximately 400' between the low points and high points in the city.

State Route 68/Redwood Road is the primary north/south transportation corridor while State Route 73/Crossroad Boulevard, Pioneer Crossing, and Pony Express Parkway are the primary east/west corridors through the city. Both of these routes are owned and maintained by UDOT. Subdivision neighborhoods, cul-de-sacs, large lots, or undeveloped land are typically accessed off of these main corridors. Foothill Boulevard/800 West is currently the only other roadway that provides a portion of the city with a contiguous access from north to south through the city. Commercial land uses and employment are also located along State Route 68/Redwood Road and State Route 73/Crossroads Boulevard. The major roads of State Route 68/Redwood Road (20,900 vehicles per day<sup>33</sup>) and Pioneer Crossing (21,600 vehicles per day<sup>34</sup>) are crucial for regional vehicle mobility. These routes are also very important for cycling mobility, as they provide continuous routes through Utah County.

### Existing Planning Document Review

The following relevant existing planning documents were reviewed to gain an understanding of existing conditions of bicycle and pedestrian facilities in Saratoga Springs:

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<sup>33</sup> UDOT AADT Data, 2014

<sup>34</sup> UDOT AADT Data, 2014

- Saratoga Springs Parks, Recreation, Trails, and Open Space Mater Plan (2011)
- Saratoga Springs Transportation Master Plan (2012)
- Saratoga Springs City Center Plan
- Saratoga Springs Land Use Element of the General Plan –100 Year Plan (2005)
- Saratoga Springs Land Use Element of the General Plan – 100 Year Plan (2005)
- TransPlan 2040 (MAG Regional Transportation Plan)
- Utah Collaborative Active Transportation Study (UCATS)
- Utah Department of Transportation Region 3 Bike Plan

## Saratoga Springs City General Plan

The Saratoga Springs General Plan Land Use Element (2005) lays out a broad vision and goals for future development of the city. Three sections highlight goals and policies directly related to the Bicycle and Pedestrian Master Plan:

### **Alternative Transportation Modes**

**Goal 1.0:** Reduce the number of vehicular trips required by residents to accomplish employment and other activities.

#### **POLICIES:**

1.1 Be responsive to the infrastructure needs of the community that support home shopping, home banking, electronic neighborhood meetings, telecommuting and other alternatives to travel.

1.2 Where appropriate, require the construction of pedestrian connections between adjoining developments.

### **Pedestrian Trails**

**Goal 1.0:** Provide a network of pedestrian trails, including sidewalks, walkways, and hiking/jogging trails throughout the City as a viable alternative to automobiles.

#### **POLICIES:**

1.1 Require installation and maintenance of a continuous, safe, and aesthetically pleasing network of pedestrian trails throughout the City.

1.2 Develop design standards for each type of pedestrian trail to minimize hazards (e.g. lighting, surface texture, landscaping, automobile pedestrian conflicts).

1.3 Reduce physical barriers for the handicapped who might use these facilities.

1.4 Require sidewalks on both sides of all roads unless facilities for other modes of transportation are planned, particularly on arterial and collector roads.

1.5 Require access for pedestrian traffic to and from all parts of commercial development. This should include bus stops, handicapped loading, crosswalks, traffic signals, sidewalks and roadways.

1.6 Work closely with the Alpine School District in reviewing locations for future schools and bus stops to minimize the necessity of children crossing or waiting for buses on arterial roads.

1.7 Consider maintenance costs in the planning and design of sidewalks, trails, landscaping, and other alternative transportation modes or recreational facilities.

### **Bicycle Trails**

Goal 1.0: Provide a network of bicycle trails throughout the City.

#### **POLICIES:**

1.1 Require installation and maintenance of a continuous and aesthetically pleasing network of bicycle trails throughout the City.

1.2 Provide a balance of each type of bicycle trail, where appropriate, to satisfy the transportation as well as the recreation needs for residents of the City.

1.3 Develop design standards for bicycle trails that will integrate bicycle trails with other modes of transportation and that will be buffered from surrounding land uses for safety.

1.4 Coordinate road improvement projects with construction of bicycle trails.

1.5 Require bicycle trail access to commercial and recreational sites.

1.6 Require bike racks at shopping centers, public buildings, schools, parks, transportation, nodes, etc.

1.7 Enforce State laws and local ordinances concerning the use of bicycles to promote bicycle safety.

### **Parks, Recreation, and Open Space**

Goal 6.0: To provide a recreational trail system with trail heads in strategic locations for access to the mountains and existing parks.

#### **POLICIES:**

6.1 Encourage the completion of the Jordan River Parkway Trail.

6.2 Require the completion of trails along major arterial roadways.

6.3 Where applicable, ensure the development of the Welby Jacob Canal Parkway and the development of trails along other canals as well as utility corridors and rail right-of-ways.

6.4 Plan for east-west trail connections in the urbanized areas of the City.

6.5 Encourage the completion of a comprehensive Parks and Trails Element of the General Plan identifying exact locations and alignments, and secure rights of way/easements.

6.6 Encourage the design and implementation of multi-use trails as indicated.

6.7 Maintain public access to State lands.

## 2040 Metropolitan Transportation Plan

The Metropolitan Transportation Plan notes that “as Utah Valley continues to grow and urbanize, the need and demand for multi-use paths, neighborhood connections, on-street bike lanes, sidewalks and pedestrian friendly development increases.” Planned bicycle and pedestrian projects in Saratoga Springs include a SR-68 / Redwood Road buffered bike lanes, Pony Express Parkway Trail, Lehi Main Street On-street bike facilities, Utah Lake Shore Trail, and an SR-73 Trail.

## Utah Collaborative Active Transportation Study (UCATS)

The Utah Collaborative Active Transportation Study was a joint planning effort between UDOT and the Utah Transit Authority (UTA) to identify a regional bicycle network throughout the Wasatch Front. As part of this plan, the project team identified locations across the Wasatch Front that could potentially have high levels of bicycle and pedestrian activity or demand for facilities, based on factors like housing and employment densities, demographic information, and proximity to destinations like shopping, schools, and parks. In Saratoga Springs, the areas of highest demand are located in the Harvest Hills neighborhood and around commercial districts on Redwood Road.



## Adjacent Community Plans

Saratoga Springs is bordered on the north/east by Lehi, and Eagle Mountain on the west. Both bordering cities have completed a bicycle and pedestrian master plan, and where possible connections have been identified to provide continuous facilities between the communities.

## Existing and Planned Bicycle and Pedestrian Facilities

This section inventories the existing network of facilities to accommodate active transportation, which is a term that usually refers to walking and bicycle trips, but can include many forms of transportation powered by human energy, such as skateboards, kick scooters, or rollerblades. To be effective, active transportation systems should be designed to provide a network of facilities that accommodate a diversity of equipment and skill levels. For instance, it is not unusual to have side paths in a corridor with bike lanes; experienced adult riders may choose to ride at higher speeds adjacent to vehicle travel lanes, whereas a 12-year old riding to school would probably feel more comfortable on a path or sidewalk separated from traffic.

Similar to the roadway networks that connect destinations for automobiles, active transportation networks get people from point A to point B on trails, quiet neighborhood streets, side paths, sidewalks, and bike lanes. For the purposes of this plan, active transportation facilities are distinguished in terms of “On-Street Bicycle Facilities” and “Off-Street Pedestrian & Bicycle Facilities.”

**On-Street Bicycle Facility:** portion of the roadway that has been designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists.

**Off-Street Pedestrian & Bicycle Facility:** separate from roadways for use of bicyclists, pedestrians, and other non-motorized user groups. Commonly referred to as shared use paths, multi-use paths, side paths, and trails. Often hard surface asphalt or concrete but can also be unpaved.

### On-Street Bicycle Facilities

On-street bicycle facilities are limited to a few corridors within Saratoga Springs. Redwood Road north of 400 South has a marked bike lane, as does Pony Express and 2100 North. Pioneer Crossing also has a shoulder bikeway, however future widening may remove this bike facility. **Figure 1** provides an overview of existing on-street bicycle facilities.



## Off-Street Pedestrian & Bicycle Facilities

Saratoga Springs has leveraged new development to include sidewalks and multi-use pathways as part of its subdivision regulation requirements. The City has also developed a robust trails system to provide recreational amenities for the community. Gaps in these systems are limited primarily to areas where development has yet to occur. **Figure 2** provides an overview of existing off-street bike and pedestrian facilities.

Mountain biking is becoming an increasingly important recreation amenity for Saratoga Springs. While the city does not currently have designated mountain biking trails, the neighboring community of Eagle Mountain invested in 30-acre amenity called the Mountain Ranch Bike Park. Connections to this regional facility and more informal mountain bike routes are viewed as key components to the bicycle network.



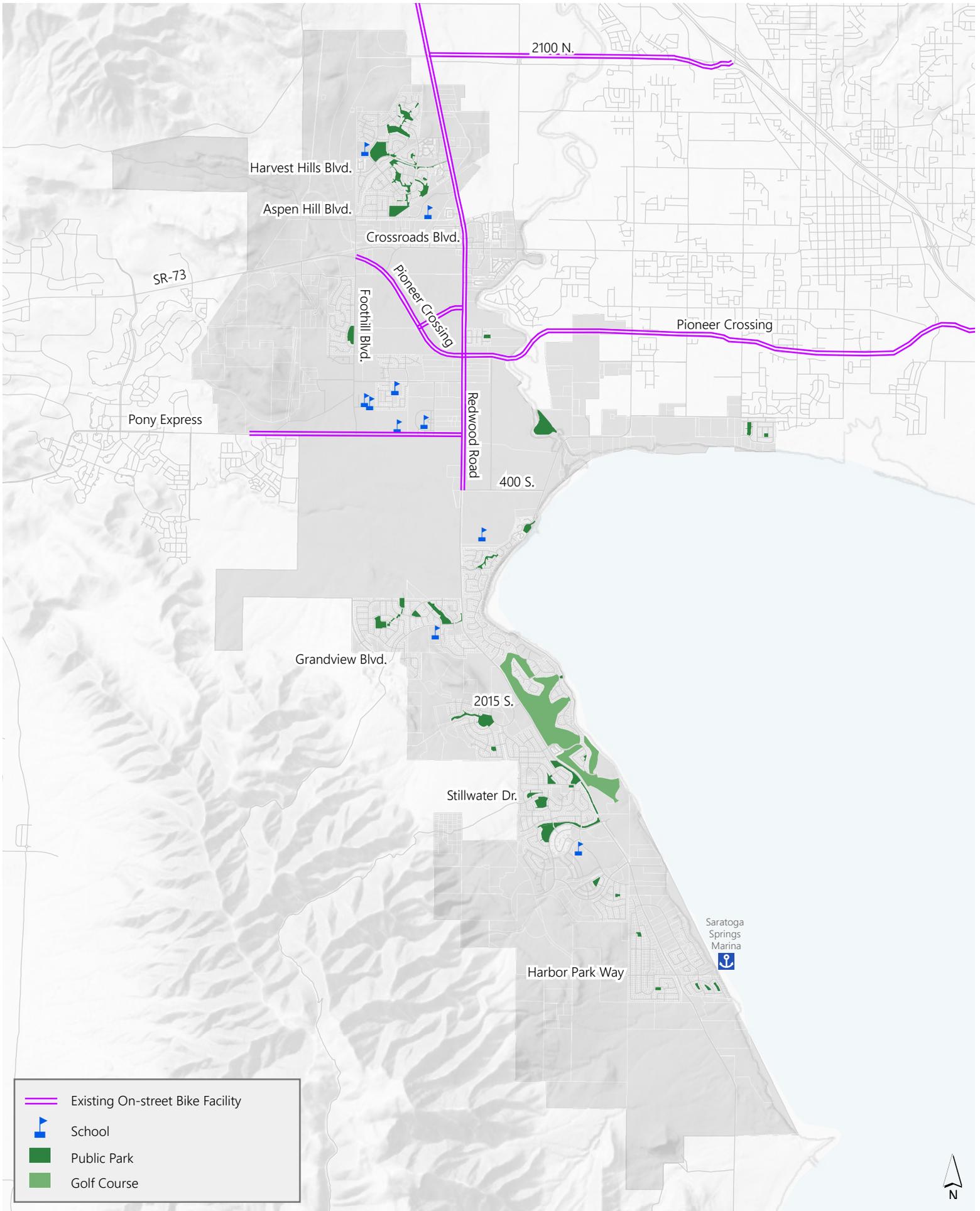


Figure 1: Existing On-Street Bicycle Facilities

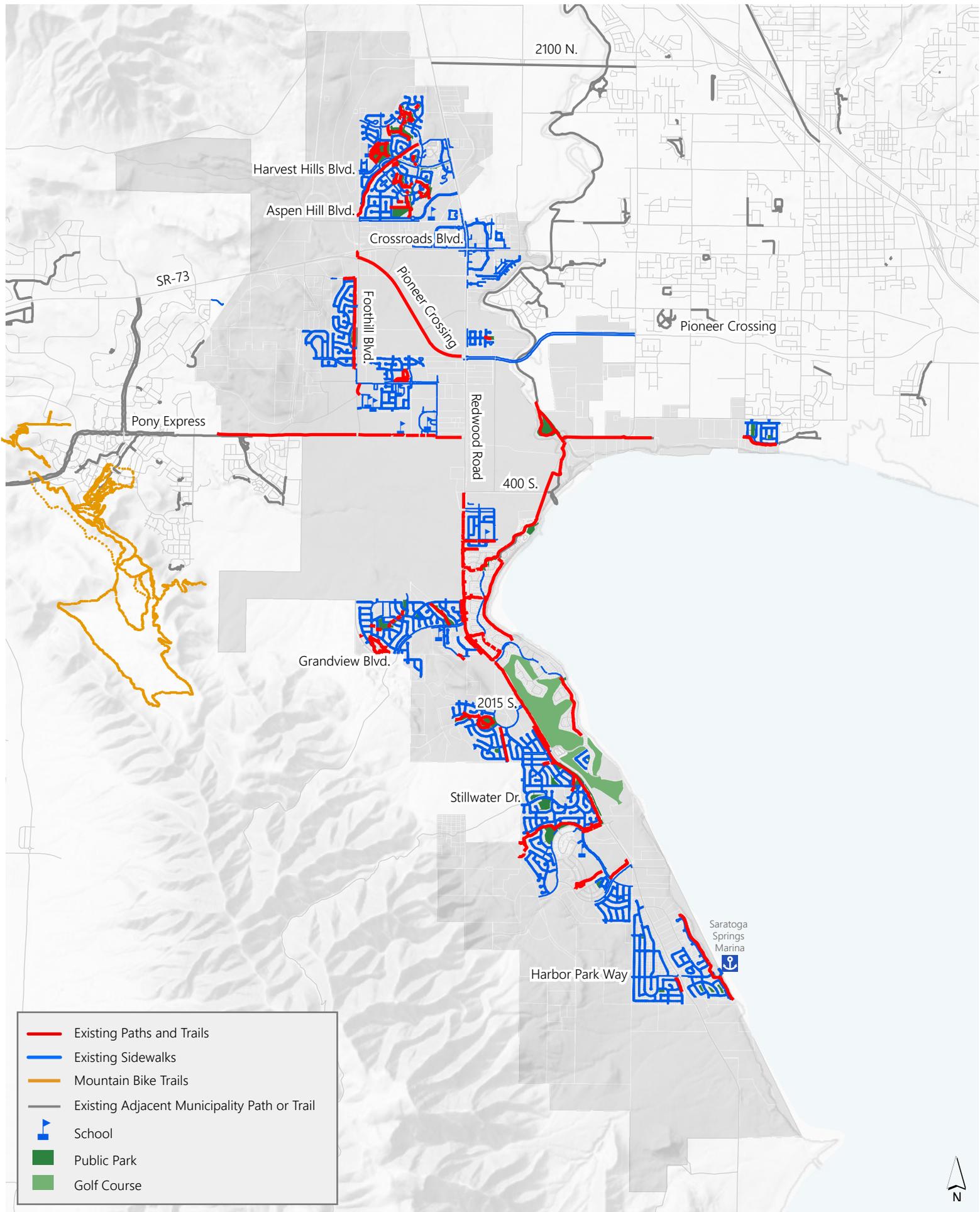


Figure 2: Existing Off-Street Bike/Ped Facilities

## Schools

### Elementary

- Harvest Elementary (2105 Providence Drive) is located in the Harvest Hills neighborhood which has several path and trail facilities and a robust sidewalk network. However, connections outside of the neighborhood to the rest of the city are limited.
- Thunder Ridge Elementary (264 North 750 West) is located just north of Pony Express Parkway and west of Redwood Road. It is bordered by a shared-use path on 400 N and on Foothill Boulevard and a path is also being constructed on Pony Express Parkway. Connectivity is limited even with these facilities as they do not connect to major subdivisions to the north or south.
- Horizon School (682 W. Marie Way) is a special education school located adjacent to Thunder Ridge Elementary and houses pre-kindergarten to high-school.
- Saratoga Shores Elementary (1415 S. Parkside Drive) is located just off of Grandview Boulevard and west of Redwood Road. Grandview Boulevard has a shared-use pathway and there is a signalized crossing across Redwood Road, which also has a shared-use path in this location. The surrounding neighborhoods also have a robust sidewalk network. Connections to the north, however, are limited.
- Sage Hills Elementary (3033 Swainson Avenue) is located just south of Village Parkway and west of Redwood Road. Village Parkway has a shared-use path, as does Redwood Road running north. The surrounding neighborhood has a robust sidewalk network, but there is limited connectivity to the rest of the city.
- Legacy Farms Elementary is currently under construction at the northwest corner of School House Road and High Point Drive. It is anticipated that the school will open in the fall of 2016. According to the Legacy Farms Community Plan, there will be a 5' sidewalk network around the school and also access to an 8' multi-use trail on the south side of High Point Drive.



### Junior High

- Vista Heights Middle School (484 Pony Express Parkway) is located southeast of Thunder Ridge Elementary. Similar to Thunder Ridge Elementary, connectivity is limited to the north and south due to gaps in the shared-use network.

### High School

- Westlake High School (99 N. 200 W.) is located east of Vista Heights Middle School. Similar to Vista Heights Middle School, connectivity is limited to the north and south due to gaps in the shared-use network.

### Charter Schools

- Lakeview Academy (527 W. 400 N.) is located west of Thunder Ridge Elementary. Similar to Thunder Ridge Elementary, connectivity is limited to the north and south due to gaps in the shared-use network.

## Barriers and Safety

### Barriers

Several barriers exist that limit bicycle and pedestrian travel in Saratoga Springs. These include:

- The major north-south facility, Redwood Road, is a high-traffic roadway with vehicles speeds around 50 mph. This is intimidating for cyclists and pedestrians, especially at intersections with other large roadways.
- Bicycle and pedestrian facilities have generally been built as part of commercial and residential development; undeveloped parcels create gaps in the network.
- Destinations such as schools and commercial areas are primarily located near Redwood Road between SR-73 and Pony Express Parkway. High-stress roadways and incomplete networks contribute to uncomfortable and indirect travel conditions.
- There are few support amenities provided for pedestrians and cyclists, such as way-finding signage and bike racks.

### Safety

Pedestrian and bicycle related crash data between 2010 and 2015 was provided by UDOT and analyzed by Fehr & Peers. There were a total of 9 pedestrian related crashes and 9 bicycle related crashes. **Figure 3** highlights where these crashes occurred as well as their severity. While the crashes were fairly geographically dispersed, several occurred along the Redwood Road corridor, including one of the two fatal crashes. The second fatal crash occurred on Foothill Boulevard near SR-73.



## Transit

Saratoga Springs is currently served by one bus line which serves Pony Express, Redwood Road and the Harvest Hills neighborhood during peak hours. The nearest FrontRunner stations are located in American Fork, approximately 5 miles to the east and in Lehi, 4-5 miles to the northeast, depending on the route with no direct connection. The American Fork station is accessed via the Pioneer Crossing corridor, while the Lehi station is accessed using the 2100 North corridor. Both corridors currently have bicycle and pedestrian facilities, however accessing these corridors from Saratoga Springs remains a challenge due to gaps in the bicycle network linking subdivisions to these corridors.

In the long term, Saratoga Springs is planning for transit facilities near the intersections of Pony Express and Redwood Road and Pioneer Crossing and Redwood Road. However, there are no projects scheduled in this area in the near term.

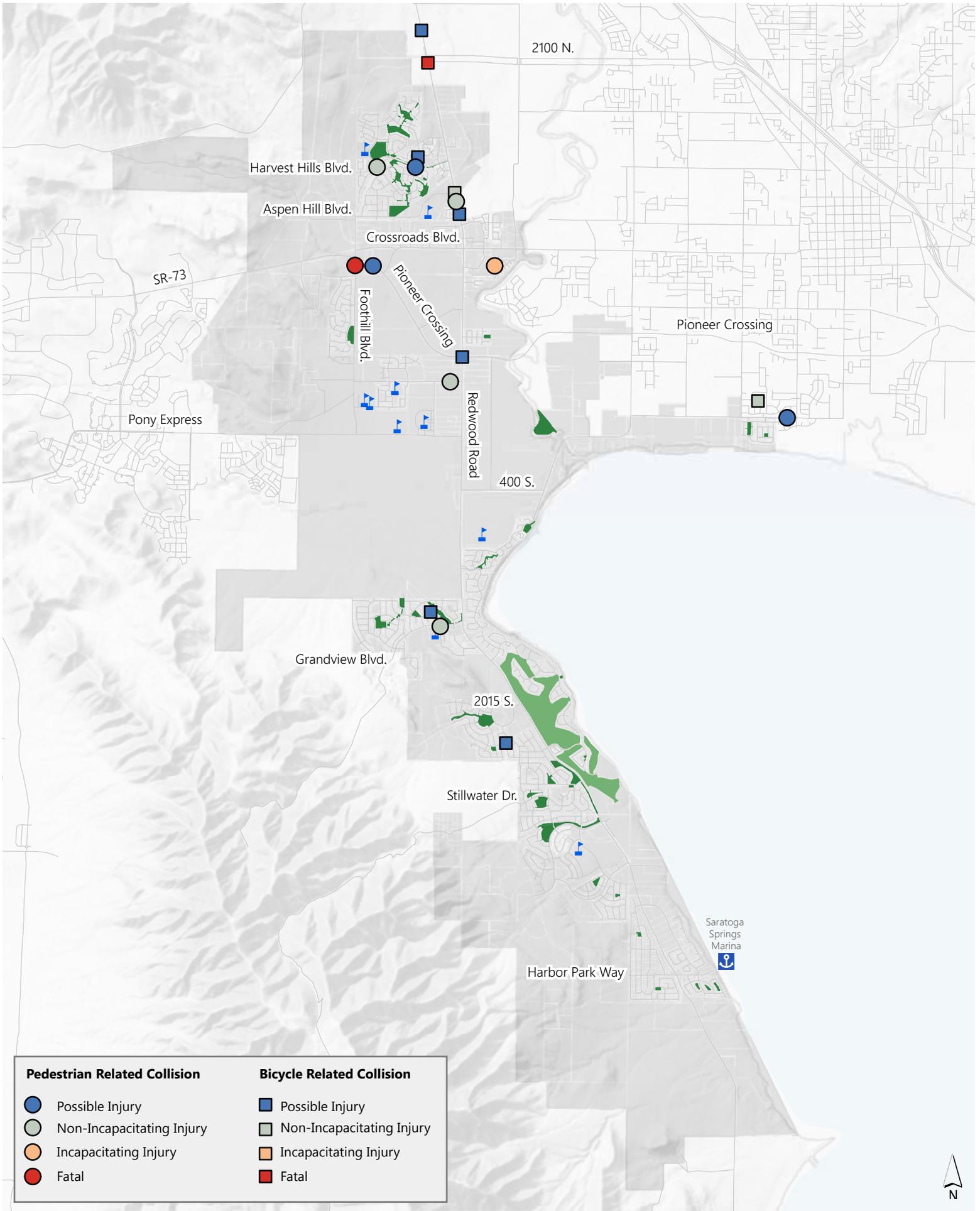


Figure 3: Collisions

## chapter four

# public outreach and input

Public outreach is a key component of any master planning effort. The objective of this outreach was to reach a broad, diverse public in which to discuss ideas for an improved bicycling and pedestrian environment in Saratoga Springs. Public outreach was conducted in a variety of ways including a project website, Needs and Attitudes Survey, an in-person public event, and an “online open house.”

## Needs and Attitudes Survey

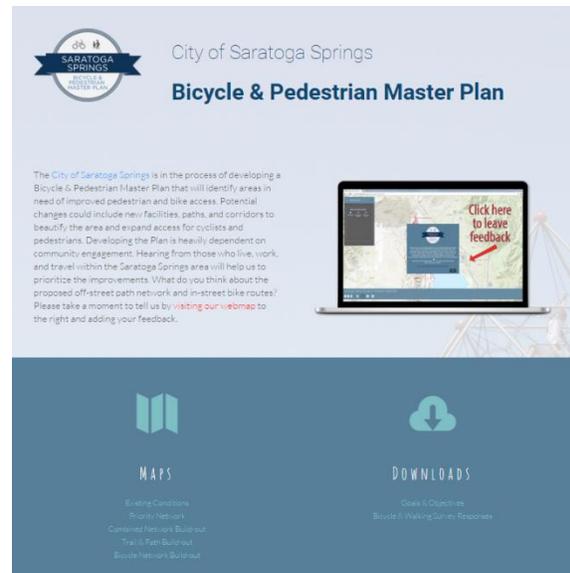
An online Needs and Attitudes Survey was conducted between July and August (2015) to understand public attitudes and preferences. The survey was used to identify priorities from those who live, work, play, and travel in and around Saratoga Springs. The survey had 11 multiple choice and several open-response questions as well as four optional demographic questions at the end. There were 168 unique responses to the survey. It is noted that responses represent the opinions of people who voluntarily took the survey, and may not represent the opinion of the majority of people in Saratoga Springs or those who may be affected by this plan.

## Demographics

94% of respondents live in Saratoga Springs, 38% recreate here, 16% work here, and 3% go to school here. There was a nearly even male-female split among respondents, with slightly more females than males completing the survey. When asked their age range, respondents answered predominantly in the 26-44 year old age range, with few 25 and under or over 70.

## Walking

- Walking Conditions – A plurality (**43%**) of respondents rated **overall walking conditions fair**; only 3% rated them excellent.
- Walking Frequency – More than **75%** of respondents **walk at least a few times a week**, with 31% of the total walking more than four times per week. Very few said that they never walk.



## Bicycling

- Bicycling Conditions – Rated less favorably than walking conditions, with almost 75% rating conditions fair or poor.
- Bicycling Frequency – 18% said that they never ride a bike. The most common response, however, was riding a few times per month (33%) with about 50% riding at least a few times per week, if not more. It should be noted that people who are already comfortable bicycling are typically more likely to take a survey of this kind.

### Types of Bicyclists Who Responded to the Survey

- 17% are strong and fearless (typically do not need dedicated facilities)
- 50% are enthused and confident bicyclists (prefer bike lanes)
- 30% are interested in bicycling but concerned about safety (prefer more separation)
- 5% were not interested at all

It is noted these results very likely reflect a respondent group that is more confident and engaged in cycling activities than the general population.

Types of Facilities – People rated the following facilities from **most** to least **likely to encourage them to ride more** (Theme: more separation is more desirable)

1. Off-street, paved shared use path
2. Protected bike lane
3. Paint-buffered bike lane
4. Painted bike lane
5. Shared roads

## Walking and Bicycling

### Most Common Reasons for Walking and Bicycling in Saratoga Springs

1. Improve my health
2. Be outdoors
3. Reduce stress
4. Be with family

### Most Desired Destinations

1. Paved, off-street paths
2. Parks, pools, recreation areas
3. Friends' houses
4. School

What prevents people in Saratoga Springs from walking and bicycling more? (Respondents could select more than one)

1. Lack of complete sidewalks, bike lanes, or paths (80%)
2. Traffic or dangerous behavior by motorists (speeding, not yielding) (54%)
3. Lack of crossings (28%)

4. Destinations are too far away (27%)

Top three improvement priorities (could select more than one)

1. New or improved sidewalks, crossings, bike lanes, and shared use paths (88%)
2. Better connectivity to parks and recreation (66%)
3. Safer routes to schools (43%)

## Public Outreach

In addition to the Needs and Attitudes Survey, there were two opportunities for the public to provide input on the Plan. The purpose of the initial in-person event was to inform the public about the project and solicit open-ended feedback about facilities, locations, and issues. The purpose of the second “online open house” was to present the recommendations of the plan via an interactive web application and obtain feedback for prioritizing the recommendations. These comment opportunities were advertised through the Saratoga Springs city newsletter, flyers, project website, Facebook, and by directly contacting interested parties, including Home Owner’s Associations.



### Splash Days Event

The first open house was held at the Saratoga Springs Splash Days event at Neptune Park. Over 25 people stopped at the booth and half of the visitors provided comments. Materials at the event included welcome and project boards, a comment map, objectives exercise and a survey flyer.

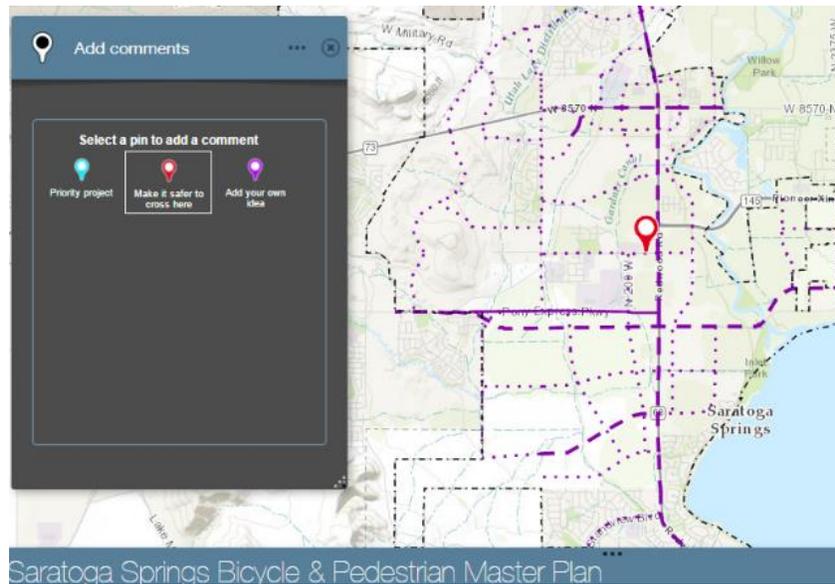
### Comments

Several comments were received and are listed below.

- Harvest Hills is isolated and hard to get down to the city
- Connect Shea Park
- Provide additional connections/wayfinding to Jordan River Trail
- Signage improvements at the bridge under Pioneer Crossing (SR-145) bridge
- Gravel paths should be paved to improve conditions for cyclists
- There is not enough shoulder along Redwood Road south of the golf course
- Continue proposed trail along Utah Lake
- Heavy trucks going to the gravel pit are a safety hazard
- Median along Redwood Road presents access issues

## Online Open House

The online open house was administered through the project website. This forum presented the proposed bicycle/pedestrian networks and priorities, and provided an interactive web map to collect comments. Compared to a traditional open house, the online open house extends the comment period over a longer time to allow engagement from a variety of constituents.



A total of 55 comments were made via the interactive web map, which were used to make edits to the proposed bicycle and pedestrian networks. Because the web map collects comments that are referenced to a spatial location, comments were also analyzed to identify geographic clusters and high priority areas. **Figure 5** provides a map of comment densities. Red areas had high comment density while blue areas had lower comment densities.

## Field Tour to Salt Lake City, Utah

Members of the Steering Committee participated in a field tour of bicycle and pedestrian facilities in Salt Lake City. The purpose of this trip was to educate decision makers on the different bicycle and pedestrian treatment types and supporting systems. This field trip provided the opportunity to observe wayfinding signage, bicycle signals, buffered bike lanes, GREENbike (bike share), protected bike lanes / cycletrack, green-painted shared lanes, left turn bike boxes, different bike parking styles, and lighted pedestrian signage.



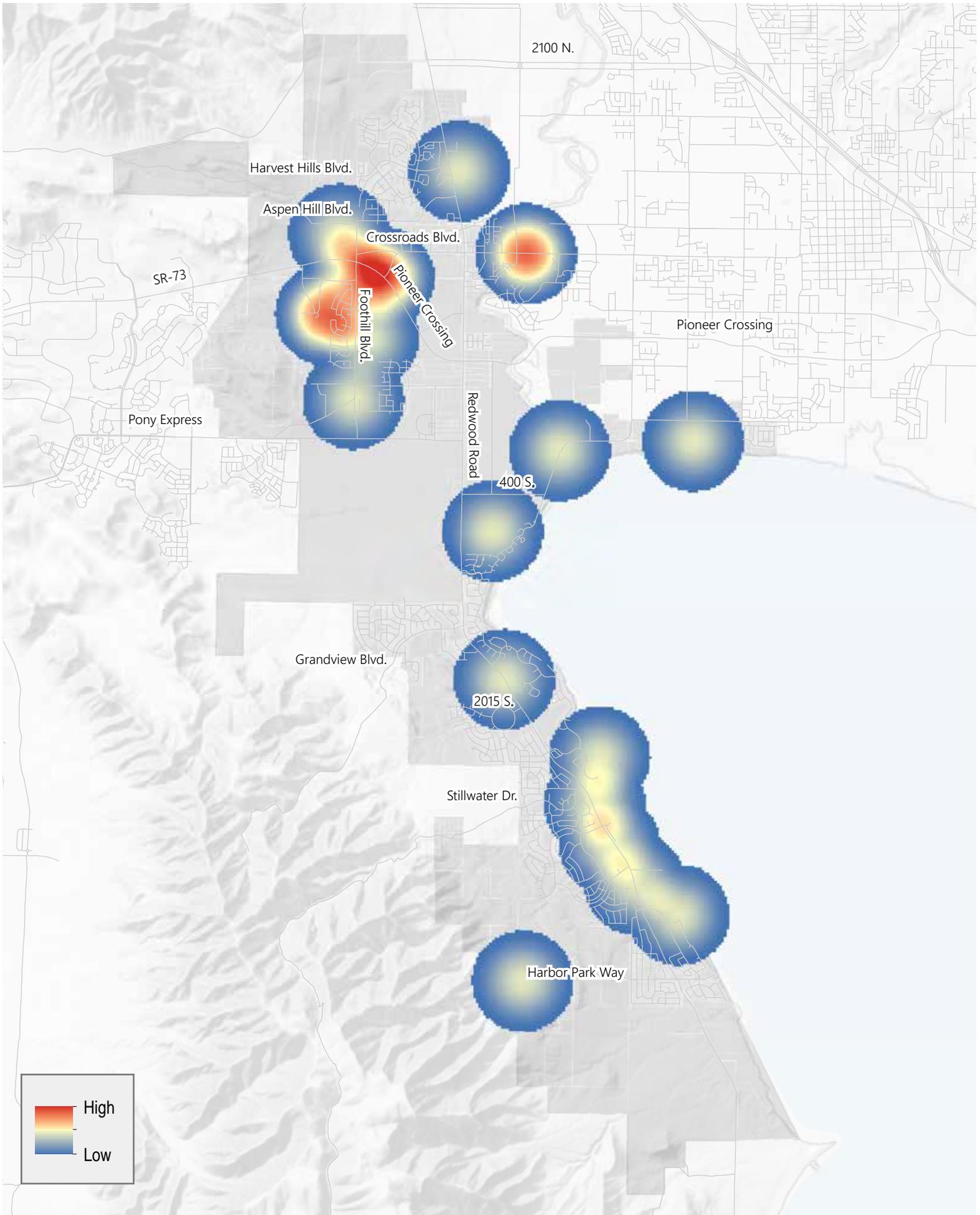


Figure 4: Public Comment Geographic Clusters

## chapter five

# proposed system & project prioritization

The proposed active transportation network is designed to fulfill the vision for walking and bicycling in Saratoga Springs. The proposed system is the result of field reviews, discussions with the Steering Committee, input from the public, and engineering judgment. Once completed, the active transportation network will provide safe and direct travel paths throughout Saratoga Springs for those who walk or bike for recreation or as part of their commute.

## On-Street Bicycle Facilities

The proposed on-street network is designed for more confident and experienced bicyclists traveling in Saratoga Springs. Corridors selected for inclusion in the network are targeted for specific improvements in this Plan, such as the installation of bicycling lanes. However, unless explicitly prohibited, bicyclists are allowed on all streets and roads regardless of whether the streets and roads are a part of the bikeway network.

**Figure 5** illustrates the existing and proposed on-street bicycle network. The proposed system includes about 70 miles of new on-street bikeway facilities such as bicycle lanes and buffered bicycle lanes. **Table 1** shows the number of proposed miles for each bikeway classification.

**TABLE 1: SUMMARY OF PROPOSED ON-STREET BIKE NETWORK**

Facility Type	Existing (miles)	Proposed (miles)	Total (miles)
<i>Bike Lane</i>	8.1	33.0	41.1
<i>Buffered Bike Lane (2')</i>	0	13.5	13.5
<i>Buffered Bike Lane (3')</i>	0	21.0	21.0
<b>Total</b>	8.1	67.4	75.6

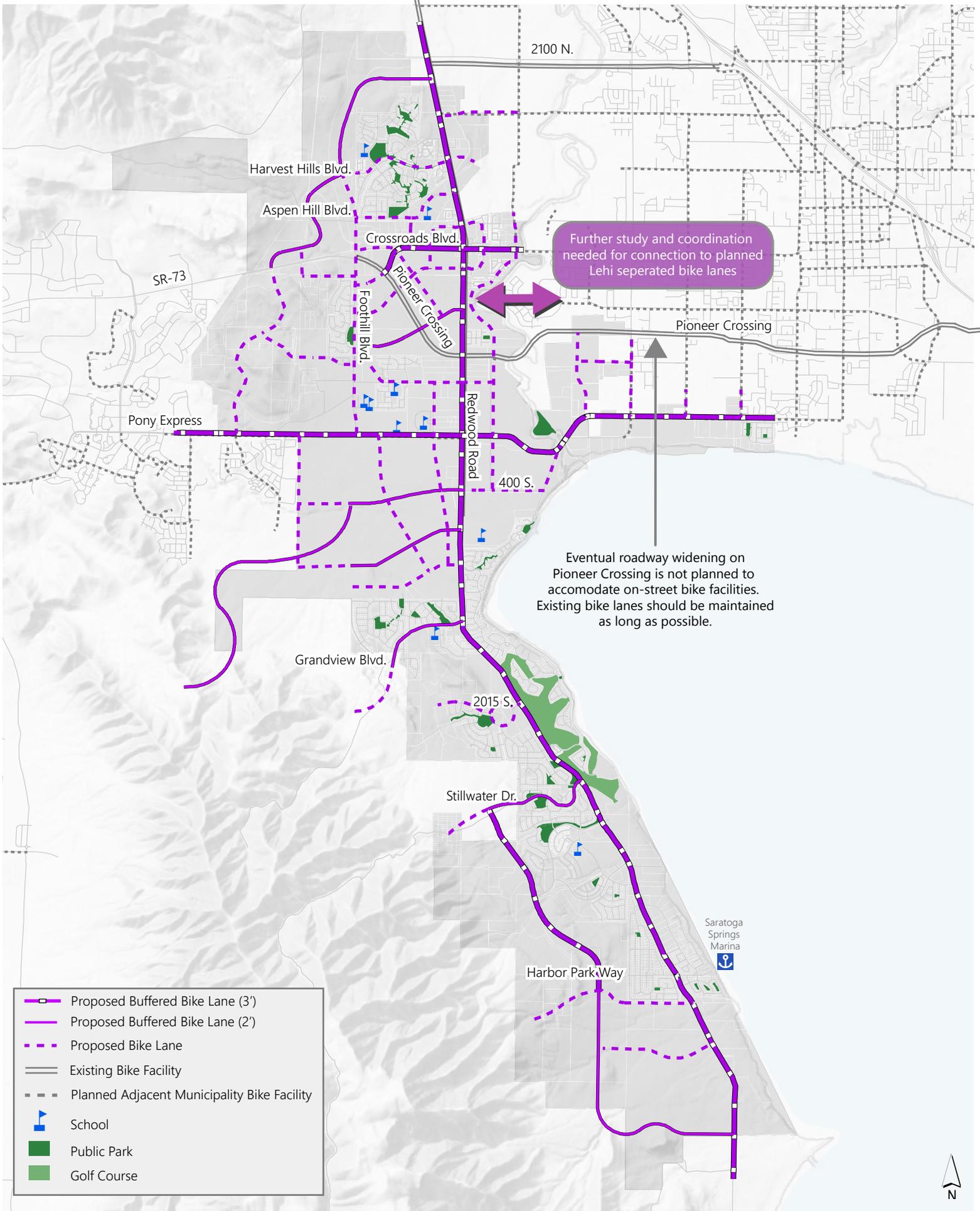


Figure 5: Existing and Proposed On-Street Bike Facilities

## On-Street Bicycle Network Design Methodology

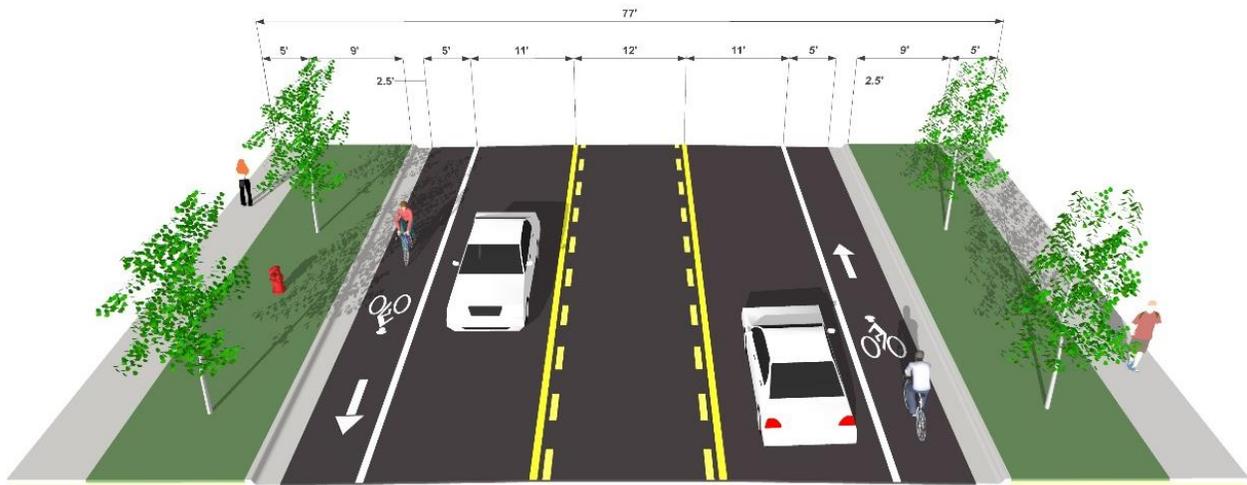
The following approach was used to create the Plan:

- The existing conditions map was overlaid with identified corridors from the input gathered from the Steering Committee and the public.
- These corridors were combined with access to destinations such as schools, parks, and commercial areas to create a preliminary bicycle network.
- The Transportation Master Plan and Parks, Recreation, Trails, and Open Space Master Plan were reviewed to identify future connections and facility types.
- The preliminary bicycle network was checked against existing and proposed networks in adjacent communities to ensure regional connectivity.
- The preliminary bicycle network was reviewed to ensure adequate spacing of facilities, closure of gaps within the network, and addressing of safety concerns.
- Initial bicycle facility types were created based on revised cross-section standard drawings, functional classification, field work, and discussions with the City.
- The complete bicycle network was reviewed with the Steering Committee and checked to ensure connectivity within Saratoga Springs and to adjacent communities.

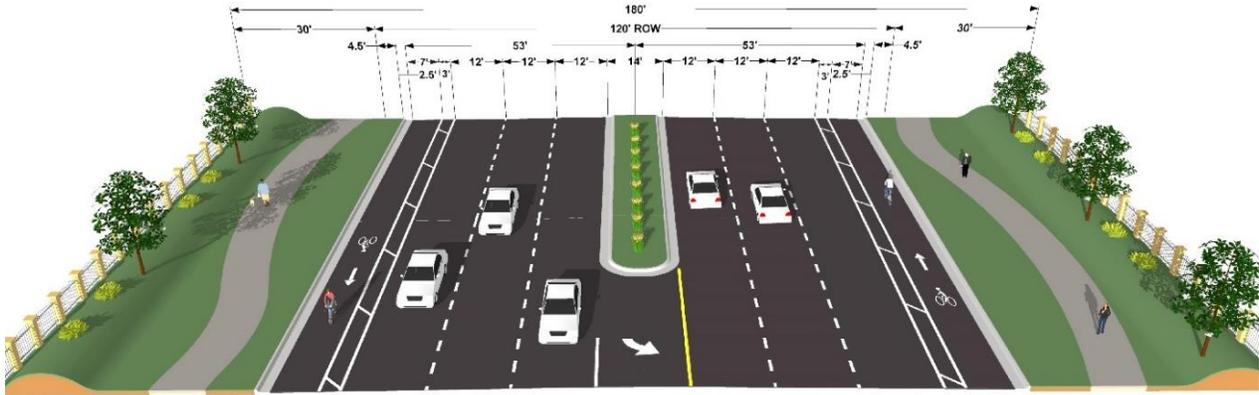
## Proposed Facility Types & Cross-sections

The proposed on-street bicycle network is composed of bicycle lanes and buffered bicycle lanes. Roadway cross-sections, shown on the following page, were developed using the street typology from the Transportation Master Plan (see **Appendix A** for all street typologies).

**Bike lanes** provide a restricted right-of-way and are designated for the use of bicycles with a striped lane and signage on a street or highway. They can increase bicyclists' safety and comfort by providing a visual separation between modes. Bicycle lanes are generally five to six feet wide.



**Buffered bike lanes** are bike lanes that provide a greater level of separation from vehicular traffic and/or parked vehicles by creating a buffer adjacent to the bicycle lanes through striping. Buffered bike lanes typically include a two to three foot striped buffer adjacent to a five to six foot bike lane. Buffers can be painted or can include vertical elements like a concrete curb or plastic bollards, which provide additional protection for users.



### Bicycle Facility Decision Matrix

While the proposed cross-sections provided in Appendix A provide bicycle infrastructure recommended based on roadway types, the context of roadways change over time. To assist Saratoga Springs in determining appropriate bicycle facility types in the future, bicycle facility guidance has also been developed. **Appendix C** contains guidance on appropriate facility types based on conditions including the number of lanes, traffic volume, and speed. If these attributes increase, a higher degree of separation is recommended to improve comfort and safety for cyclists. While the facility types identified reflect best practices, the guidance is not meant to replace engineering judgement. Each situation is unique and facility types should be selected on a case-by-case basis.

### Bicycle Project Prioritization

Much of the future on-street bicycle network is expected to be incorporated into new roadway construction. However, there are several existing roads on which bike lanes are proposed, and these were identified as priority project locations. From the City perspective, these are priority projects because they will not be funded through new development and will require the City and government partners to fund these projects. **Figure 6** illustrates these priority projects.

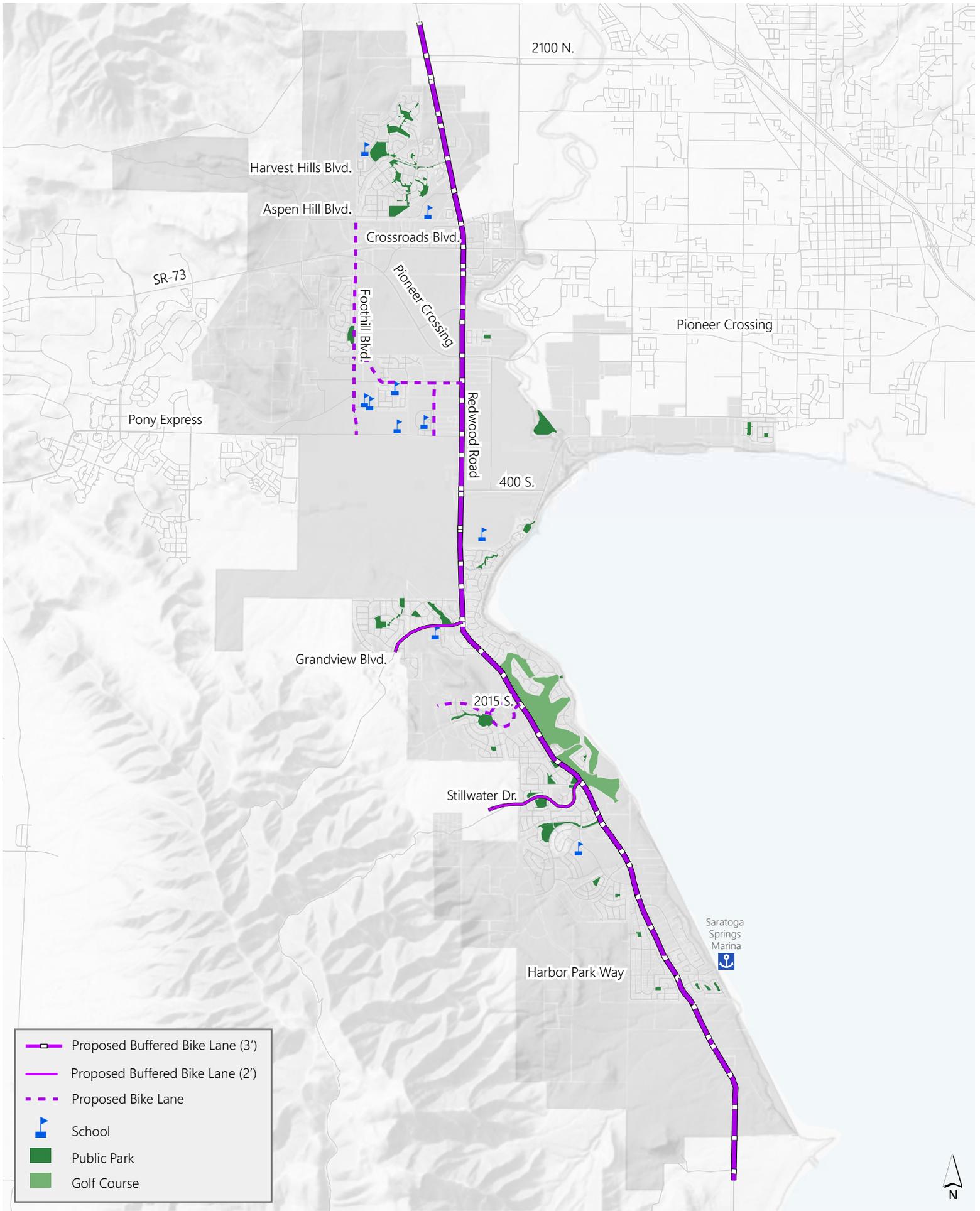


Figure 6: Proposed Priority On-Street Bike Facilities

## Off-Street Pedestrian & Bicycle Facilities

The provision of off-street infrastructure is essential to creating a comfortable walking environment. It is also important to provide these facilities to serve cyclists who are uncomfortable using on-street bicycle facilities. Saratoga Springs is ahead of many other Wasatch Front communities in providing sidewalk infrastructure. City development requirements include provisions to ensure sidewalks are integrated in new residential and commercial development. Beyond neighborhood sidewalk networks there is a need for paved paths and soft surface trails that can provide connections between subdivision and serve as recreation facilities.

The proposed off-street network consists of trails and pathways that are designed to connect destinations and provide recreational opportunities. While sidewalks are usually oriented toward pedestrians, many user groups can utilize these facilities, especially those designated as multi-use trails, including road and mountain bicyclists, and equestrians.

**Figure 7** illustrates the existing and proposed off-street network. The proposed system includes a total of approximately 100 miles of new facilities. **Table 2** shows the number of proposed miles for each classification. While this plan does not specify locations for crossing treatments, guidance on selecting appropriate treatments can be found in **Appendices D and E**.

**TABLE 2: SUMMARY OF PROPOSED OFF-STREET BIKE/PED NETWORK**

Facility Type	Existing (miles)	Proposed (miles)	Total (miles)
<b><i>Off-Street Paved Pedestrian &amp; Bicycle Facilities</i></b>	26.2	93.4	119.7
<b><i>Soft Trails</i></b>	1.5	35.4	36.9
<b><i>Sidewalk</i></b>	140.4	N/A	N/A
<b><i>Total*</i></b>	168.1	269.2	297.0

\*Future sidewalks are not defined in the Plan, and therefore only existing sidewalk is included in total calculations.

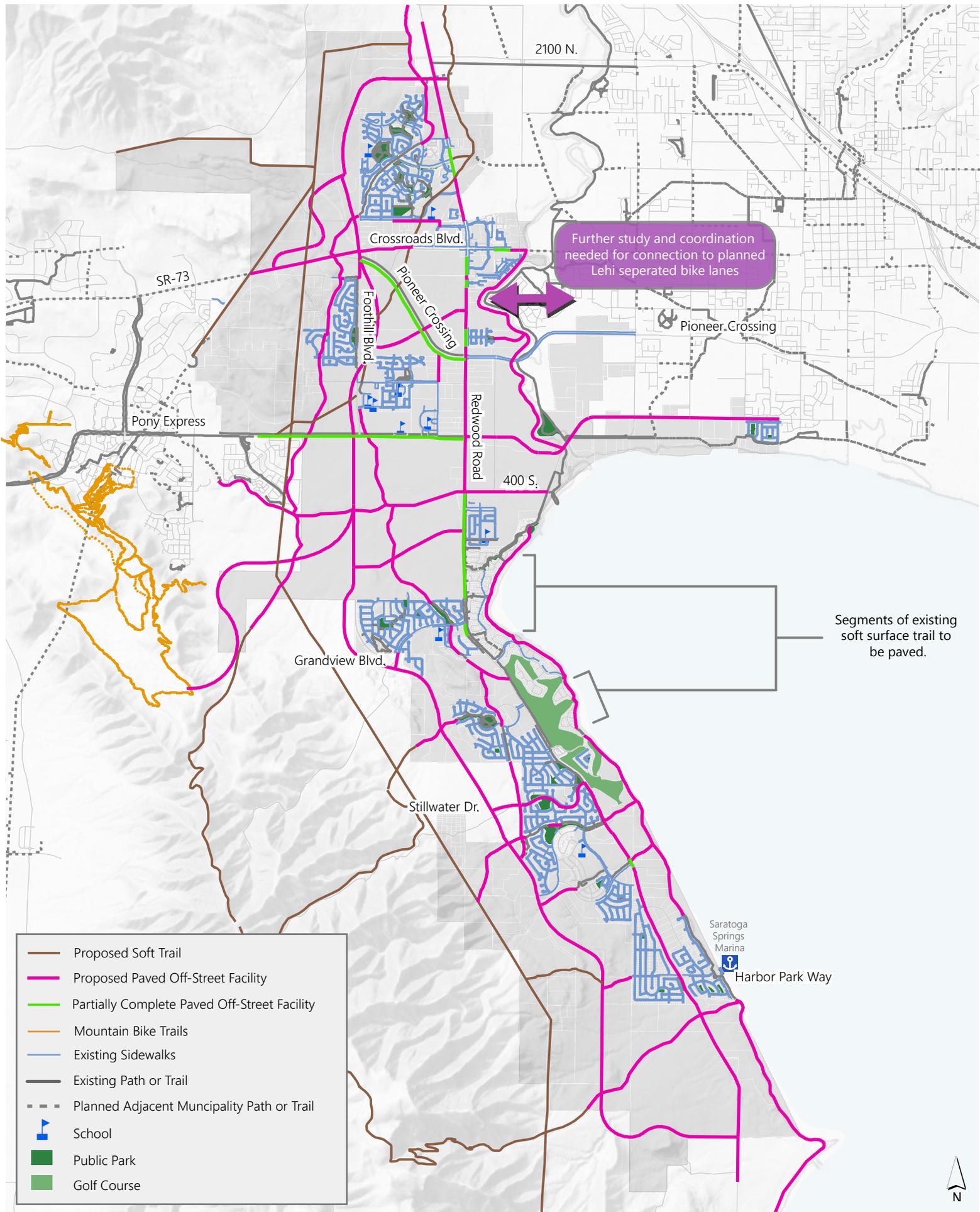


Figure 7: Existing and Proposed Off-Street Bike/Ped Facilities

## Off-Street Network Design Methodology

The proposed system was developed according to the following methodology:

1. Gaps in the existing trail and pathway network were identified through reviewing existing geospatial data.
2. Corridors for prioritization were selected based on the input gathered from the Steering Committee and the public and corridors with access to destinations such as schools, parks, trails, and commercial areas.
3. The preliminary network was reviewed to ensure closure of gaps within the network, addressing of safety concerns.
4. The pedestrian network was reviewed with the Steering Committee and checked to ensure connectivity within Saratoga Springs.

## Project Prioritization

Like the on-street bike network, much of the off-street network will be constructed through future development. However, some projects should be pursued by the City. These projects fill gaps in the network and complete regionally significant multi-use trails and pathways. **Figure 8** illustrates these priority projects.

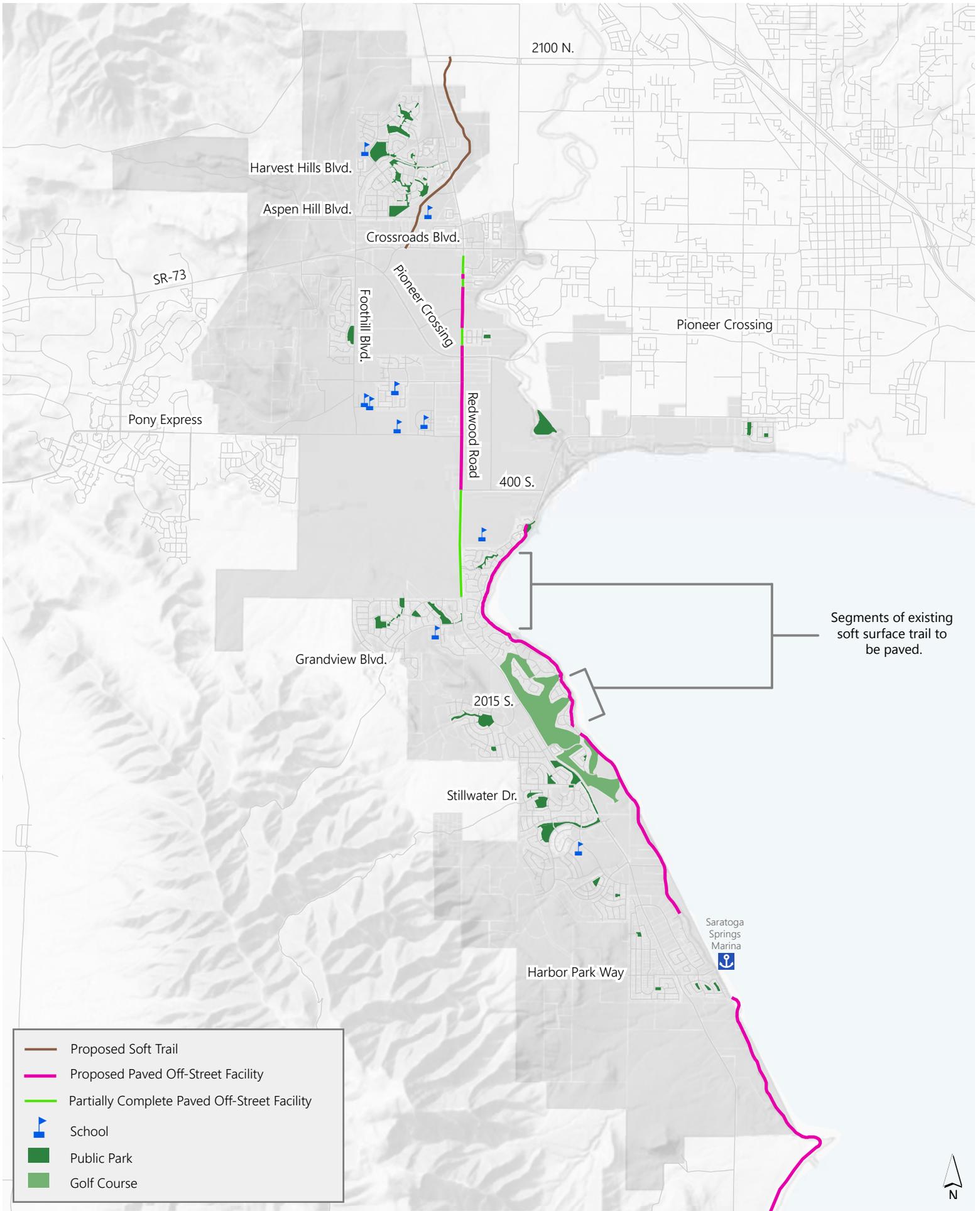


Figure 8: Proposed Priority Off-Street Bike/Ped Facilities

## Amenities & Recommendations

Active transportation networks can be supported through other amenities such as lighting, trash cans, water fountains, and benches. Saratoga Springs should endeavor to provide these, and other amenities, wherever possible. Several key amenities are recommended based upon field visits and discussion with the Steering Committee. These recommendations are described in **Table 3**. Additional amenities and bicycle and pedestrian facility treatments are listed in **Appendix D** (“toolbox”).

**TABLE 3: SUMMARY OF ACTIVE TRANSPORTATION AMENITIES**

Tool	Description	Benefits	Considerations
<p><b>Corridor Lighting</b></p>  <p>Image source: <a href="http://www.pedbikeimages.org/">www.pedbikeimages.org/</a></p>	<p>Roadway and pedestrian sidewalk lighting to improve driver visibility of pedestrians during low light conditions</p>	<p>Improves driver visibility of pedestrians and provides them more time to react to a potential conflict</p>	<p>Should be considered along all corridors</p>
<p><b>Way-finding Signs</b></p>  <p>Image source: NACTO</p>	<p>Posting a series of pedestrian and bicycle way-finding signs that orient pedestrians to walking and biking destinations along a corridor</p>	<p>Encourages more walking and bike trips by providing people with a reference point to a destination</p>	<p>Applied in locations where there are pedestrian and bicycle destination or attractors</p> <p>Should be scaled to be legible for appropriate user</p>
<p><b>Bicycle Repair Stands</b></p> 	<p>Do-it-yourself bicycle repair stands offer an air pump and basic tools to make minor bicycle repairs.</p>	<p>Encourages bicycle use by removing concerns related to common maintenance and repair issues.</p>	<p>Repair stands should be located near short-term and long-term bicycle parking.</p>

## Bicycle Parking

Bicycle parking is an important end-of-trip facility for those riding bicycles for any purpose, allowing secure storage of bicycles and comfortable access to destinations. Saratoga Springs should consider adopting a bicycle parking ordinance that would provide both short and long-term bicycle parking.

As part of this Plan, a bicycle parking best practice was developed based on guidance from the Association for Pedestrian and Bicycle Professionals' (APBP) Bicycle Parking Guidelines Manual (2nd Edition) and



and bicycle parking generation code language and design standards from Lindon, American Fork, and Eagle Mountain, Utah. **Appendix B** contains the best practice guidance.

## Crosswalk and Intersection Guidance

### Crosswalk Decision Matrix

To assist Saratoga Springs in creating safe crosswalks, this Plan includes a Crosswalk Decision Matrix (**Appendix E**), which provides guidance for determining where to install crosswalks at uncontrolled locations. The Crosswalk Decision Matrix is a toolbox of elements to improve pedestrian mobility, visibility, and safety at uncontrolled locations. It will assist the City in making decisions about where basic crosswalks (two stripes) can be marked; where crosswalks with special treatments, such as high visibility crosswalks, flashing beacons, and other special features, should be employed; and where crosswalks will not be marked due to safety concerns resulting from volume, speed, or sight distance issues. This matrix provides guidance about the type of treatments appropriate on various streets and under various conditions. While the strategies in the matrix reflect best practices, the guidance is not meant to replace engineering judgment. Each situation is unique and walking safety treatments must be selected on a case-by-case basis.

### Separated Bikeways at Intersections

Creating safe intersections for bicyclists is often challenging. Even if linear bicycle facilities are acceptable, if the interaction between automobiles and bicycles at intersections is not appropriately addressed it can lead to safety issues and lower utilization. **Appendix F** provides guidance to transition bike lanes through right turn lanes and roundabouts, as well as guidance related to signal detection.

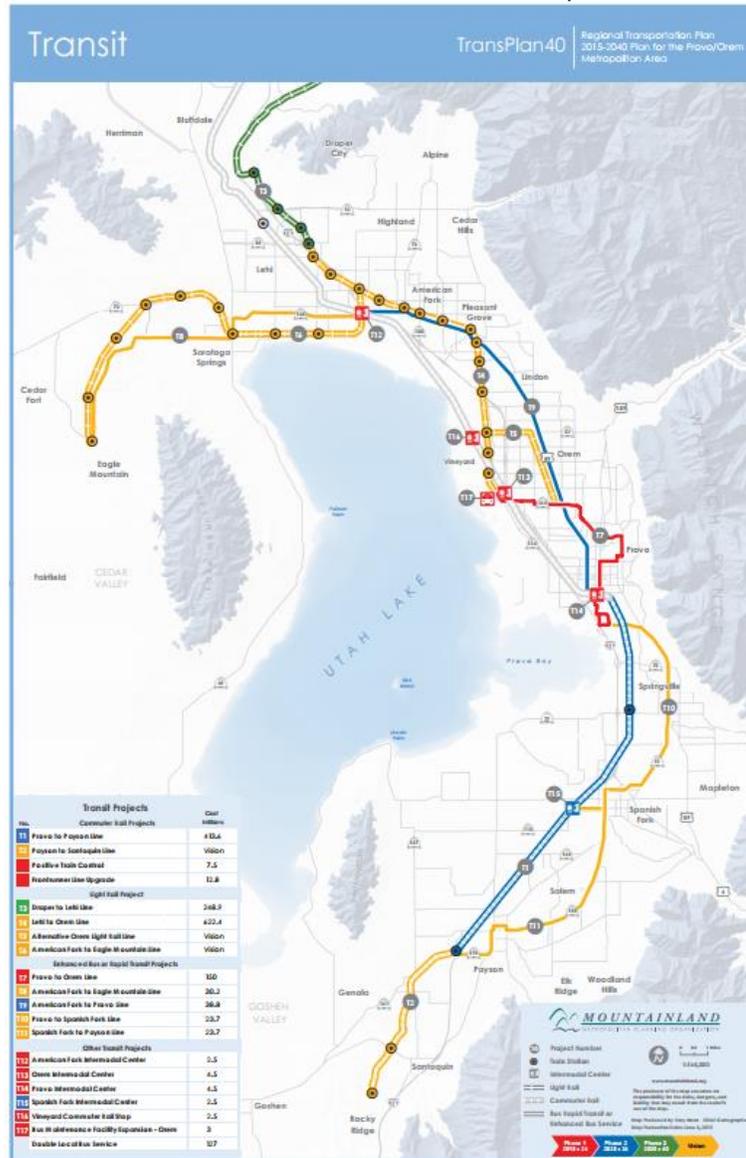
## Future Transit Integration

The 2015-2040 MAG long-range transportation plan identifies two projects with connections to Saratoga Springs; a Bus Rapid Transit (BRT) route with service between American Fork and Eagle Mountain and a Light Rail project with service between Lehi and Eagle Mountain. Both projects are identified as “Vision/Unfunded” with no specific timeline for

development. However, connections to these future projects and other interim transit investments are critical to the future bike and pedestrian networks. Transit can work hand-in-hand with these networks, allowing users to use both systems together to make longer trips, or providing alternatives during inclement weather. Providing seamless and convenient “first/last mile” connections to transit makes using both networks more feasible.

In the short term more frequent transit service is most likely to be added to major corridors like Redwood Road, Pony Express Parkway, and Crossroads Blvd. Saratoga Springs should pay special attention to making effective first/last mile connections to these corridors. For future fixed-guideway projects, multi-modal access to station areas should be a key focus. The Utah Transit Authority (UTA) has developed a First/Last Mile toolbox that is an excellent reference for providing connections to station areas.

MAG TransPlan40 Transit Map



## chapter six

# capital costs & maintenance

There are two costs associated with developing the proposed active transportation network – capital costs for constructing the facilities, and ongoing maintenance costs to ensure that the facilities in good condition. While new development will cover some of the upfront capital costs, Saratoga Springs will need to plan for appropriate resources for new construction, retrofits, and regular maintenance activities.

## Capital Cost Assumptions

This section discusses capital costs of bicycle and pedestrian facilities recommended in this Plan. Table 4 provides a summary of capital costs by facility type as well as priority.

### On-Street Bike Facilities

The planning-level cost is \$13,000 per mile (bi-directional) for a standard bike lane. The planning-level cost is \$21,000 per mile (bi-directional) for a buffered bike lane. These costs assume sufficient curb-to-curb width to install the bike facility and associated pavement markings, but that modifications to existing striping would be necessary to make room. It assumes that the road is in good condition and doesn't require maintenance or rehabilitation as part of the striping project.

### Off-Street Bike/Ped. Facilities

The planning-level cost is \$686,000 per mile (centerline) for paved paths, assuming asphalt paving of an 8'-10' pathway. Right-of-way acquisition and other soft costs including design and engineering are not included in this estimate.

The planning-level cost is \$32,000 per mile for 8'-10' trail of a soft-surface material such as soil or chipped wood. Costs from the Saratoga Springs Park, Recreation, Trails, and Open Space Master Plan were adjusted using a CPI inflation calculator to develop the cost estimate in 2015 dollars.

In most cases, sidewalk construction costs will be covered through future development. However, sidewalks cost estimates are provided to better understand the costs incurred by developers. A standard 5-foot sidewalk with curb and gutter is roughly \$75 per linear foot.

TABLE 4: CAPITAL COSTS SUMMARY

Priority Network			
	Miles	Per Mile Unit Cost	Cost
<b>Off-Street Paved Pedestrian &amp; Bicycle Facilities</b>	12.0	\$686,000	\$8,250,800
<b>Soft Trails</b>	2.1	\$32,000	\$66,200
<b>Bike Lane</b>	4.9	\$13,000	\$63,900
<b>Buffered Bike Lane (2')</b>	1.8	\$21,000	\$38,200
<b>Buffered Bike Lane (3')</b>	11.6	\$21,000	\$243,700
<b>TOTAL</b>	32.4		\$ 8,662,800
All Recommendations			
	Miles	Per Mile Unit Cost	Cost
<b>Off-Street Paved Pedestrian &amp; Bicycle Facilities</b>	93.4	\$686,000	\$64,091,200
<b>Soft Trails</b>	35.4	\$32,000	\$1,133,000
<b>Bike Lane</b>	33.0	\$13,000	\$428,900
<b>Buffered Bike Lane (2')</b>	13.5	\$21,000	\$282,500
<b>Buffered Bike Lane (3')</b>	21.0	\$21,000	\$440,000
<b>TOTAL</b>	196.2		\$66,375,600

## Maintenance Recommendations

The City of Saratoga Springs has invested considerable resources in the construction of shared use paths and sidewalks, both of which provide valuable recreational and transportation benefits to local residents and visitors. The City currently allocates about \$50,000 annually to the Parks Department for snow removal and plant management along trails. Trails outside of established parks are essentially treated as linear parks and maintained by the Parks Department. On-street bike lanes are currently maintained as part of regular roadway maintenance.

As Saratoga Springs continues to grow, capital costs and therefore maintenance costs will increase as more and different types of facilities are installed. Currently, an element of disconnect or disparity exists between growth and budgeted maintenance costs, as well as between expectations of facility quality and financial resources. Additional operations and budgetary planning will benefit the City as it handles current and future demand for high quality facilities and associated maintenance activities. The following maintenance recommendations seek to establish a structured yet flexible approach to maintenance activities for existing and proposed on and off-street bicycle and pedestrian facilities.

The physical condition of bicycling and walking facilities like bike lanes, paved shoulders, dedicated shared-use paths, and sidewalks, is an important consideration when residents consider choosing walking or bicycling for transportation or other uses.

Primary on-street bikeway maintenance activities include sweeping, maintaining a smooth roadway, and snow removal. Pavement management and overlay projects are good opportunities to add or improve bicycle facilities within the existing roadway width.

Typical off-street bicycle and pedestrian facility maintenance activities include sweeping, pavement management, snow removal, weed abatement, landscaping, and mowing.

Developing a city-wide maintenance management plan will be useful in ensuring that responsibility is assigned to different departments within the City and that regular maintenance is completed efficiently and uniformly. The following recommendations provide a menu of options that will improve Saratoga Springs' existing and future maintenance program. Recommendations should be incorporated into the City's construction standards, development code, master development agreements, standard cross sections, City Code (where applicable), and other zoning and maintenance definitions and standards.

### On-Street Maintenance Activities

Implementing bikeway facilities is important and keeping them in good condition equally so. On-street bikeways are currently maintained as part of standard roadway maintenance programs, however wide shoulders and bike lanes often have debris, like rocks, sand, and snow, in them, making bicycle travel within those designated areas more difficult. Extra emphasis should be put on keeping bike lanes and roadway shoulders clear of debris and snow, as well as keeping vegetation overgrowth from blocking visibility or creeping into the roadway. Maintenance activities could be driven by a regular schedule or by maintenance requests from the public. Typical maintenance costs for on-street bikeways are shown in **Table 5** at the end of this section.

#### Street Sweeping

When a bicycle lane becomes filled with debris, bicyclists are forced into the motor vehicle lane. Poor bikeway maintenance can contribute to crashes and deter potential bicyclists unwilling to risk flat tires and skidding on roadways. The City of Saratoga Springs maintains all public roadways within city limits that are not state routes except for Cedar Fort Rd/SR-73, Redwood Rd/SR-68, Pioneer Crossing, and SR-145, which are UDOT-maintained, state highway facilities.

Periodic checks should be made of the on-street bikeway network. Street sweeping of on-street facilities should be coordinated with the management agency's roadway maintenance program to ensure that the roadway is cleared curb to curb and that debris is not swept into the bike lane.

#### *Sweeping Guidance*

- Establish a seasonal sweeping schedule that prioritizes roadways with bikeways.
- Sweep bikeways whenever there is an accumulation of debris.
- In curbed sections, sweepers should pick up debris; on open shoulders, debris can be swept onto gravel shoulders.
- Pave gravel driveway approaches to minimize loose gravel on paved roadway shoulders.

- Sweeping of off-street paths may require special equipment such as bobcats equipped with sweeping attachments or specialized path sweepers.
- Perform additional sweeping in the spring to remove debris that has accumulated during winter.
- Perform additional sweeping in the fall in areas where leaves accumulate.

### Pavement Surface

Bicyclists are more sensitive to pavement quality than motorists because of reduced speeds, narrower tire widths, and, typically, lack of suspension or dampening systems. Compaction after trenches and other construction holes are filled can negatively affect bicycle travel. Uneven settlement after trenching can affect the roadway surface nearest the curb where bicycles travel. Sometimes compaction is not achieved to a satisfactory level, and an uneven pavement surface can result due to settling over the course of days or weeks.

Roadway paving aggregate material choice is an important issue when roads are repaired or repaved. The City should investigate using a smaller chip size, such as ¼ inch or ½ inch, on at least the most popular on-street biking routes to improve pavement quality and bicyclist comfort. A seal coat, which is applied after the chip, will greatly improve smoothness of the roadway surface.

#### *Pavement Surface Guidance*

- Maintain a smooth pothole-free surface.
- Ensure that the finished surface on bikeways does not vary more than ¼ inch on new roadway construction and existing roadway repaving or resurfacing.
- Maintain pavement so that ridge buildup does not occur at the gutter-to-pavement transition or adjacent to railway crossings.
- Inspect the pavement 2 to 4 months after trenching construction activities are completed to ensure that excessive settlement has not occurred.
- During chip seal maintenance projects, if the pavement condition of the bike lane is satisfactory, it may be appropriate to chip seal the travel lanes only. However, use caution when doing this so as not to create an unacceptable ridge between the bike lane and travel lane.

Pavement overlays represent good opportunities to improve conditions for on-street bikeways if done carefully. A ridge should not be left in the area where bicyclists ride (this occurs where an overlay extends part-way into a shoulder bikeway or bike lane). Overlay projects also offer opportunities to widen a roadway or to re-stripe a roadway with bike lanes.

#### *Pavement Overlay Guidance*

- Extend the overlay over the entire roadway surface to avoid leaving an abrupt edge.
- If the bike lane pavement is of good quality, it may be appropriate to end the overlay at the shoulder or bike lane stripe provided no abrupt ridge remains.
- Ensure that inlet grates, and manhole and valve covers are within ¼ inch of the finished pavement surface and are made or treated with slip-resistant materials.
- Pave gravel driveways to property lines to prevent gravel from being tracked onto shoulders or bike lanes.

### Off-Street Maintenance Activities

Shared-use paths and trails require regular maintenance to provide a quality experience to users. Maintenance activities can generally be categorized into one of two types: routine maintenance, which is

done frequently to annually; and, major or capital maintenance, which involves more intensive activity at a less than annual frequency.

Not every shared-use path or trail will have the same needs and levels of expenditure. It is estimated that approximately \$500 to \$1,500 per mile be budgeted annually for routine maintenance of shared-use paths and trails.

### Sidewalk Maintenance

Sidewalks enable residents to safely access friends' homes, commercial areas, community resources, transit stops, schools, and other destinations on foot. Sidewalks are also integral to Saratoga Springs' future economic centers as they will provide spaces to meet, eat, and engage with one's community. Maintaining sidewalks clear of debris and obstructions is essential to maintaining comfort and safety for and limiting liability in the city.

#### *Sidewalk Guidance*

- Work with property owners to enforce regular sidewalk maintenance.
- Repair and reconstruct sidewalks where necessary because of tree root heaving, settling, deterioration, landslides, or other natural occurrences.

### Snow Removal

In the event of a snow storm, the City uses as many as five snow plow trucks to clear and salt 180 lane miles of non-state highway roads (mentioned previously), sometimes 24 hour per day if necessary. The Public Works Department prioritizes which streets will be plowed first in the following order, ranked by priority: (1) collectors and streets serving schools, municipal buildings, and selected streets on steep grades; (2) main secondary routes through subdivisions connecting collector streets; (3) remaining City streets and unpaved roadways. During major snow events, the top priority streets may be cleared before and continually before any other streets in order to keep them operational; snow removal on second and third priority streets may not occur for several days after a major event.

Individual property owners, occupants, and/or homeowners are not allowed to park or allow to be parked vehicles on the street in the case of a snow event, so as to allow effective snow removal by Public Works. Residents are also responsible for removing snow and ice on and in front of private driveways and mailboxes, though snow may not be plowed into or back into the public roadway. Residents are also required to remove snow and ice from sidewalks along their property, though City crews are responsible for sidewalks in and in front of public facilities.

Winter maintenance of bicycle and pedestrian facilities is an important consideration for a city like Saratoga Springs that receives significant amounts of snowfall. The City should expect bicyclists to use the road network year round, even in inclement conditions. Providing safe conditions for bicyclists year round should be a top priority. Some communities prioritize streets with bicycle and pedestrian facilities to be plowed by 7:00 am (starting at 4:00 am), Monday through Friday, to facilitate active transportation users' commutes to school and work. Conventional on-street bike lanes can and should be plowed at the same time as the rest of the street and should not require a considerable amount of extra effort. Protected bike lanes may require a small plow or brush to clear snow and/or debris, but should be maintained at the same time as the rest of the roadway. The planted strip separating the sidewalk from the roadway and/or the protected bike lane buffer can be used for snow storage.

Snow removal along proposed on-street paths and off-street trails will require additional or new efforts from Saratoga Springs maintenance crews in several departments. The City should attempt to provide

snow removal for paths and sidewalks (where they are not currently being cleared) throughout the rest of the city as the proposed system develops. Immediately clearing snow from all paths will likely not be feasible because of time and budget resources, but department staff and maintenance crews should establish a prioritization that focuses on 1) regionally-significant trails and paths, 2) trails and paths that connect to schools, 3) trails and paths that connect to retail/commercial centers and 4) trails and paths that connect to transit stops.

*Snow Removal Guidance*

- City should employ a proactive or anti-icing strategy and have a plan for the removal of unused de-icing surface material debris after storms that accumulates in and around bike facilities.
- A prioritization schedule for snow removal is necessary and should focus on primary routes and destinations that impact the highest volume of bicyclists and pedestrians immediately following snow events.
- Plow all the way to the curb to clear bike lanes and rideable shoulders.
- Snow removal on off-street trails and on-street paths may require special equipment such as skid steers equipped with plows or smaller pickup truck plows.

Annual Maintenance Cost Estimates

The following tables provide cost estimates and recommendations for ongoing maintenance of the existing and proposed active transportation network.

**TABLE 5: MAINTENANCE COSTS**

Existing Plus Proposed Network			
	Miles	Per Mile Unit Cost	Cost
<b><i>Paved Paths</i></b>	119.7	\$500 - \$1,500	\$59,800 – \$179,500
<b><i>Soft Trails</i></b>	36.9	\$500 - \$1,500	\$18,500 - \$55,400
<b><i>Bike Lane</i></b>	41.1	\$1,800-\$3,700	\$74,000 - \$152,100
<b><i>Buffered Bike Lane (2')</i></b>	13.5	\$3,900 - \$5,900	\$52,500 - \$79,400
<b><i>Buffered Bike Lane (3')</i></b>	21.0	\$3,900 - \$5,900	\$81,700 - \$123,600
<b><i>TOTAL</i></b>	232.1		\$286,500 - \$590,000

Capital Maintenance

Major or capital maintenance activities typically involve more intensive maintenance repairs such as pavement seal coating, pavement overlays, pavement reconstruction, or other structural rehabilitations. Needs can vary widely based upon environmental factors, such as soil conditions, drainage, and the quality of initial construction. Any paved path surface will deteriorate over time with asphalt surfaces dropping in quality rapidly after 10 years. Preservation efforts such as seal coating extend the life of asphalt efficiently and at a lower cost than waiting for the surface to fail requiring expensive reconstruction. Overlays may be needed after multiple seal coats or after approximately 30 years of

service. A full reconstruction could be required when needed, typically at 50 years if the seal coat and overlay have been provided at regularly, proposed intervals.

Concrete paths will require significantly less capital maintenance than asphalt paths. Although they may require isolated jacking or replacement, generally limited capital maintenance expenditures can be expected for upwards of 50 years.

Financial planning for major or capital maintenance can be challenging. Typically asphalt shared-use paths require greater capital maintenance activities with age and ultimately require full reconstruction at some point. Some jurisdictions stay focused on eventual reconstruction and treat this as a maintenance item to be budgeted for, whereas some treat this as a separate capital project to be considered at a later date in the future. Depending on the existing age and the level of effort, major or capital maintenance can require an average budget of between \$2,000 and \$7,000 per mile per year. Some years may require more expensive maintenance while others require none.

**TABLE 6: ON-STREET BIKEWAY MAINTENANCE FREQUENCY AND COST OPINIONS**

<b>Maintenance Activity</b>	<b>Material</b>	<b>Frequency</b>	<b>Estimated Cost</b>
<b><i>Pavement sweeping</i></b>	All	Weekly or monthly as needed	Part of regular street sweeping activities and costs
<b><i>Snow removal</i></b>	All	Simultaneous with regular roadway snow removal; otherwise, as needed	Depends on conditions, ~\$150/mile
<b><i>Tree and shrub trimming</i></b>	All	5 months to 1 year	Part of regular street sweeping activities and costs
<b><i>Sign repair and replacement</i></b>	Signs and poles	Every 10 years	\$300/sign
<b><i>Bike lane re-striping</i></b>	Paint	Every 1 to 2 years	\$3,700/mile
<b><i>Buffered bike lane re-striping</i></b>	Paint	Every 1 to 2 years	\$5,900/mile
<b><i>Shared lane marking re-painting</i></b>	Paint	Every 1 to 2 years	\$500/mile

TABLE 7: OFF-STREET PATH MAINTENANCE FREQUENCY AND COST OPINIONS

Maintenance Activity	Function	Frequency	Est. Annual Cost (per mi.)
<b>Path sweeping</b>	Keep paved surfaces debris free	Twice annually (once in spring and once in fall)	\$140 (x2)
<b>Litter and trash removal</b>	Keep path clean and maintain consistent quality of experience for users	Annually, or as needed	\$70
<b>Mowing path shoulders (native open space areas)</b>	Increases the effective width of the path corridor and helps protect encroachment	Twice annually, in late spring and mid to late summer	\$100 (x2)
<b>Tree and brush trimming</b>	Eliminate encroachments into path corridor and open up sight lines	Annually, or less frequently as needed	\$100
<b>Weed abatement</b>	Manage existence and/or spread of noxious weeds, if present	Twice annually, in late spring and mid to late summer	\$140 (x2)
<b>Safety Inspections</b>	Inspect path tread, slope stability, and bridges or other structures	Annually	\$20
<b>Snow removal</b>	Generally limited to urban sections of the path where year-round bike access is desired	As needed (assume 5 events)	\$120
<b>Sign and other amenity inspection/replacement</b>	Identify and replace damaged infrastructure	Annually (assume 2 sign replacements)	\$100
<b>Crack sealing and repair</b>	Seal cracks in asphalt to reduce long term damage	Annually	\$250
<b>Total</b>			\$1,420

**TABLE 8: CAPITAL OFF-STREET, SHARED USE PATH MAINTENANCE 50-YEAR SCENARIO**

Maintenance Activity	Time		Long Term Capital Costs				
<i>Seal Coat</i>	Year 10	SF	\$0.19	LF	\$1.90	Mile	\$10,000
<i>Seal Coat</i>	Year 20	SF	\$0.19	LF	\$1.90	Mile	\$10,000
<i>Overlay</i>	Year 30	SF	\$2.00	LF	\$20.00	Mile	\$105,000
<i>Seal Coat</i>	Year 40	SF	\$0.19	LF	\$1.90	Mile	\$10,000
<i>Reconstruction</i>	Year 50	SF	\$6.50	LF	\$65.00	Mile	\$343,000

**TABLE 9: ANNUAL CAPITAL BUDGETING REQUIREMENTS**

	Full Reconstruction	w/o Full Reconstruction	Before Overlay
<i>Total Cost</i>	\$479,000	\$136,000	\$20,000
<i>Cost / Year</i>	\$9,500	\$2,700	\$717

**TABLE 10: CAPITAL UNPAVED TRAIL MAINTENANCE 10-YEAR SCENARIO**

Maintenance Activity	Time		Long Term Capital Costs				
<i>Re-grade</i>	Year 2	SF	\$0.025	LF	\$0.24	Mile	\$1,320
<i>Re-grade</i>	Year 4	SF	\$0.025	LF	\$0.24	Mile	\$1,320
<i>Re-grade</i>	Year 6	SF	\$0.025	LF	\$0.24	Mile	\$1,320
<i>Re-grade</i>	Year 8	SF	\$0.025	LF	\$0.24	Mile	\$1,320
<i>Gravel Overlay</i>	Year 10	SF	\$0.20	LF	\$2.00	Mile	\$10,500
<i>Total Cost / 10 Years</i>							\$15,800
<i>Avg Cost / Year</i>							\$1,580

## chapter seven

# funding and implementation

Implementation of the proposed bicycle and pedestrian system will require funding from local, regional, state, and federal sources and coordination with multiple agencies. To facilitate funding efforts, this section presents conceptual cost estimates for the proposed system along with a brief description of past expenditures for bicycle and pedestrian facilities. The conclusion of this section provides a brief overview of overall funding and implementation strategies.

As infrastructure projects come under construction, the City should use opportunities such as roadway repaving or utility work to implement network segments that require limited changes or consist of “sign and paint only.” These features can be implemented relatively rapidly at low cost and greatly expand the network, which would both facilitate and encourage increased cycling in the City. This approach allows the City to implement more of the plan at a quicker pace, with the intent of effectively providing alternative mobility choices.

## Funding Sources

Many funding sources are potentially available at the federal, state, regional, county, and local levels for Saratoga Springs to implement the projects in the Bicycle and Pedestrian Master Plan. The majority of public funds for bicycle and pedestrian projects are derived through a core group of federal and state programs. Federal funds from the Surface Transportation Program (STP), Transportation Alternatives (TA), and Congestion Mitigation Air Quality (CMAQ) programs are allocated to UDOT and Mountainland Association of Governments and distributed by those agencies at their discretion. Other programs such as the TIGER (Transportation Investments Generating Economic Recovery) grants can be used for “shovel ready” projects that meet federal transportation goals. County or City funds may also be used to construct bicycle and pedestrian facilities.

**Table 11** provides a list of funding sources that may be applicable to projects identified in this plan. Most of these sources are highly competitive and require the preparation of applications. For multi-agency projects, applications may be more successful if prepared jointly with other local and regional agencies.

The City should also take advantage of private contributions, if appropriate, in developing the proposed system. This could include a variety of resources, such as volunteer labor during construction, right-of-way donations, or monetary donations towards specific improvements.

**TABLE 11: FUNDING OPPORTUNITIES**

Funding Opportunity	Eligible Project Types	Qualifications	Lead Agency	Submittal Specifics
Municipal Funds				
Bond Financing	Varies	Varies	Varies	Bonds can be approved by voters to fund a range of projects. A local successful precedent is the 2012 Parks and Trails Bond in Salt Lake County, which authorized \$47 million in bond funds to complete the Jordan River Parkway, the Parley's Trail, and acquire land for and construct new parks throughout the County.
Sales Tax	Varies	Varies	Varies	It is possible to pass a specified sales tax that could be used to fund active transportation improvements. Precedents include the San Diego region, which approves a half-cent sales tax in 2008 to generate funds for highway, transit, and local road (including bicycle and pedestrian) projects; and the Great Rivers Greenway in the St Louis area, where voters passed a proposition in 2000 to create a 0.1% sales tax for parks, open space and trails.
Special Assessment or Taxing Districts	Varies	Varies	Local Government	Local municipalities can establish special assessment districts for infrastructure improvements. For example, Urbandale, Iowa established a special assessment program in 1996 for building sidewalks in existing developments where they were missing. Exception clauses allowed residents to apply for hardship status, or to petition for sidewalks on only one side of the street rather than both.
Parking Fees	Varies	Varies	Local Government	Some cities have instituted parking fees to pay for infrastructure improvements. Pasadena, CA installed paid parking meters to gather revenue to maintain streets, alleys, and sidewalks in Old Pasadena, and also to provide new signs, lighting, pedestrian-friendly alleys, and other aesthetic improvements.

**TABLE 11: FUNDING OPPORTUNITIES**

<b>Funding Opportunity</b>	<b>Eligible Project Types</b>	<b>Qualifications</b>	<b>Lead Agency</b>	<b>Submittal Specifics</b>
Development Impact Fees	Varies	Varies	Local Government	Development impact fees are one-time charges collected from developers for financing new infrastructure construction and operations and can help fund bicycle and pedestrian improvements. Impact fees are assessed through a city's impact fee program.
New Construction	Varies	Varies	Local Government	Future road widening and construction projects are methods of providing bike lanes. To ensure that roadway construction projects provide bike lanes and walkways where needed, it is important that the review process includes a designated bicycle and pedestrian coordinator. Planned roadway improvements in Saratoga Springs should provide bikeways in the City.
<b>State Funds</b>				
ADA Ramps	ADA-related improvement	For missing ADA ramps on State routes only	UDOT	Applications are submitted to the Region Coordinator. Missing ramps can be found in the UDOT database from a recent survey of ramps. ( <a href="http://udot.utah.gov/main/uconowner.gf?n=13652716548952568">http://udot.utah.gov/main/uconowner.gf?n=13652716548952568</a> )
Safe Sidewalks Program	Sidewalks	Sidewalks on State routes only	UDOT	Applications are submitted to the Region Safe Sidewalk Program coordinator and require scope and cost estimate. Local jurisdiction must agree to maintenance and the sidewalk must be built within one year of money allocation. ( <a href="http://www.udot.utah.gov/main/uconowner.gf?n=104675223364328443">http://www.udot.utah.gov/main/uconowner.gf?n=104675223364328443</a> )
Community Development Block Grants-State Administered Program	Street improvement	Best if benefits low- or moderate-income populations. Part of a Consolidated Plan.	HUD, State, and Local Government	The Grantee for these grants cannot be a principal city of a metropolitan statistical area, a city with more than 50,000, or a county with a population with more than 200,000. Applications are submitted to the State. ( <a href="https://www.hudexchange.info/cdbg-state/">https://www.hudexchange.info/cdbg-state/</a> )

**TABLE 11: FUNDING OPPORTUNITIES**

Funding Opportunity	Eligible Project Types	Qualifications	Lead Agency	Submittal Specifics
State Legislation	Legislation dependent	Legislation dependent	State of Utah	<p>State legislatures can create laws that have dedicated bicycle funding components. Two examples of this are the Oregon "bike bill" which requires including bicycle and pedestrian facilities when any road, street or highway is built or rebuilt and the California Bicycle Transportation Account, which provides state funds to cities and counties wishing to improve safety and convenience for bicycle commuters.</p> <p>(<a href="http://oregon.gov/ODOT/HWY/BIKEPED/Pages/bike_bill.aspx">http://oregon.gov/ODOT/HWY/BIKEPED/Pages/bike_bill.aspx</a> and <a href="http://www.dot.ca.gov/hq/LocalPrograms/bta/btawebPage.htm">http://www.dot.ca.gov/hq/LocalPrograms/bta/btawebPage.htm</a>)</p>
<b>State Funds</b>				
Transportation Alternatives Program	Bicycle and pedestrian improvement	Funds can be used for construction, planning and design of on- and off-road facilities.	MAG and UDOT	<p>MAG funds are distributed to projects during the Transportation Improvement Plan project selection process. Most TAP projects will have an 80/20 federal/local match split. Projects can include sidewalks, trails, bicycle facilities, signals, traffic calming, lighting and safety infrastructure, and ADA improvements. Rails-to-trails conversions are also allowed. The Recreational Trails Program is included in Transportation Alternatives, as is the Safe Routes to School program.</p> <p>(<a href="http://www.fhwa.dot.gov/environment/transportation_alternatives/">http://www.fhwa.dot.gov/environment/transportation_alternatives/</a>)</p>
Community Development Block Grants-Entitlement Communities Program	Street improvement	Best if benefits low- or moderate-income populations.	HUD and Local Government	<p>Grantee is a principal city of a metropolitan statistical area, a city with a population over 50,000, or a county with a population over 200,000. Part of a Consolidated Plan.</p> <p>(<a href="http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement">http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement</a>)</p>
Surface Transportation Program	Bicycle and pedestrian improvement	Generally not used on local minor collectors with exceptions for bicycle/pedestrian walkways.	UDOT	<p>Concept reports due to MPO for consideration of programming funds.</p> <p>(<a href="http://www.fhwa.dot.gov/map21/factsheets/stp.cfm">http://www.fhwa.dot.gov/map21/factsheets/stp.cfm</a>)</p>

TABLE 11: FUNDING OPPORTUNITIES

Funding Opportunity	Eligible Project Types	Qualifications	Lead Agency	Submittal Specifics
Congestion Mitigation and Air Quality	Bicycle and pedestrian improvement	Reduce congestion or improve air quality in nonattainment or maintenance areas by shifting travel demand to non-automobile modes.	MAG	Projects must be included in the TIP. MAG calls for projects from local communities each year. ( <a href="http://www.fhwa.dot.gov/map21/factsheets/cmaq.cfm">http://www.fhwa.dot.gov/map21/factsheets/cmaq.cfm</a> )
Land and Water Conservation Fund	Bicycle and pedestrian trails, or acquisition of land for trails	Projects that create outdoor recreation facilities, or land acquisition for public outdoor recreation.	DNR	The Land and Water Conservation Fund (LWCF) provides matching grants to States and local governments for the acquisition and development of public outdoor recreation areas and facilities. The program is intended to create and maintain a nationwide legacy of high quality recreation areas and facilities and to stimulate non-federal investments in the protection and maintenance of recreation resources. 50/50 match is required, and the grant recipient must be able to fund the project completely while seeking reimbursements for eligible expenses. ( <a href="http://stateparks.utah.gov/resources/grants/land-and-water-conservation-fund">http://stateparks.utah.gov/resources/grants/land-and-water-conservation-fund</a> )
Federal Lands Access Program	Planning, engineering, construction, and other activities	Projects must be on, adjacent to, or provide access to federal lands.	UDOT	Fund is administered through UDOT in coordination with the Central Federal Lands Highway Division, which develops a Programming Decisions Committee. The Committee prioritizes projects, establishes selection criteria, and calls for projects. Next call for projects is anticipated for 2015. ( <a href="http://www.cflhd.gov/programs/flap/ut/">http://www.cflhd.gov/programs/flap/ut/</a> )
Rivers, Trails, and Conservation Assistance Program	Planning assistance for bicycle and pedestrian projects.	Staff support for facilitation and planning.	National Park Service	Projects need to be related to conservation and recreation, with broad community support, and supporting the National Park Service's mission. Applicants must submit National Park Service applications by August 1 annually, including basic information as well as letters of support. The local contact is Marcy DeMillion, at 801-741-1012 or <a href="mailto:marcy_demillion@nps.gov">marcy_demillion@nps.gov</a> .

**TABLE 11: FUNDING OPPORTUNITIES**

<b>Funding Opportunity</b>	<b>Eligible Project Types</b>	<b>Qualifications</b>	<b>Lead Agency</b>	<b>Submittal Specifics</b>
Passenger Enhancement	Sidewalk projects and bicycle infrastructure	Sidewalk must be within half mile and bike infrastructure must be within three miles of a transit stop	UTA	Funding can be completed in two ways – the lead agency will share in the cost of the construction, if the submitting agency has already done design and is planning to construct. If the project is on a priority sidewalk list for UTA, UTA will design and construct.
<b>Private or Corporate Funds</b>				
Cambia Health Foundation Children’s Health Program	Programs and possibly infrastructure	Projects must improve access to healthy foods, recreation facilities, and encourage healthy behavior for families.	Cambia Health Foundation	Grants are typically in \$50,000 - \$100,000 range. Focus is on programs. Contact foundation staff at <a href="mailto:cambiahealthfoundation@cambiahealth.org">cambiahealthfoundation@cambiahealth.org</a> for additional information. ( <a href="http://www.cambiahealthfoundation.org/programs/childrens-health">http://www.cambiahealthfoundation.org/programs/childrens-health</a> )
Bikes Belong Foundation	Bicycle infrastructure	Projects must improve the cycling environment	Bikes Belong	Bike Belong has awarded 272 grants to non-profit organizations and local governments in 49 states and the District of Columbia, since 1999.
Community Fundraising	All	Small dollar amounts	Local agency or non-profit	Lead agency manages the details, marketing, and range of a community fundraising campaign. Successful examples include Softwalks' Kickstarter campaign for sidewalk amenities in New York City, and use of volunteer labor for trail construction in Springdale, Utah. Follow link below for more ideas. ( <a href="http://www.bicyclinginfo.org/funding/sources-community.cfm">http://www.bicyclinginfo.org/funding/sources-community.cfm</a> )

## Implementation

### Plan Implementation

Saratoga Springs should regularly revisit their bicycle and pedestrian master plan to review progress in implementing projects. Key review components are described below.

#### *Implementing Projects*

City staff should review project implementation within two or three years after plan completion, to document the status of priority projects, and whether new projects from the plan should be added to current implementation efforts. At five years following plan completion, staff members should again evaluate how many priority projects have been implemented.

#### *Maintenance Budget Considerations*

As discussed in Chapter Six, developing a city-wide maintenance management plan will be key to ensuring that responsibility is assigned to different departments within the City and that regular maintenance is completed. Furthermore, as the active transportation network grows maintenance costs will also rise. The current budgetary process for managing these growing costs is insufficient. Additional operations and budgetary planning will benefit the City as it handles current and future demand for high quality facilities and associated maintenance activities. It is recommended the Saratoga Springs create a budgetary line item and set aside funds on an ongoing basis for active transportation network maintenance. This will add clarity to the budget and allow the city to prioritize this maintenance in the context of other city needs. It is also recommended that this budget be increased based on network buildout rather than a set percentage increase annually to ensure that funding is adequate for what needs to be maintained.

#### *Building Partnerships*

Relationships with regional and local transportation agencies such as UDOT, UTA, Mountainland Association of Governments, and other organizations can be helpful for Saratoga Springs while attempting to build bicycle and pedestrian networks. Staff members should establish strategic working relationships with their counterparts and leadership at these agencies, and at adjacent municipalities. Building partnerships takes time and effort, however, and the results may take some years to come to fruition. Municipalities should take stock of their partnering efforts at the three- to five-year mark following completion of a bicycle and pedestrian master plan. Staff members should re-evaluate their strategies if partnering efforts do not result in some increase of political and agency support of bicycle and pedestrian issues – other strategies or methods of building support may be necessary.

#### *Online Monitoring Feedback*

While most local and state transportation divisions have internal methods for monitoring transportation facility conditions, many have additional mechanisms for citizens to report problems. Several online options are available as well. For instance, Salt Lake City has a “Bicycle Route Maintenance Form” online, through which the public can identify cycling routes in need of maintenance work such as sweeping, pothole repair, pavement maintenance, or other problems. The form can be found online through the Salt Lake City Transportation Division website. Other cities, such as Portland Oregon, also seek online feedback on transportation conditions such as desired curb ramps, traffic safety concerns (i.e. speeding, crosswalk needs, visibility, or school zones), and street light problems. Portland’s online forms

can be found through the Portland Bureau of Transportation website. Cities may also state timelines for responding to requests – within a day, several days, or a week – which demonstrates a commitment to the public’s traveling needs. Currently, several cities incorporate crowd-sourced or volunteered geographic information (VGI) into maintenance requests. Users can submit requests for repair by sending a GPS-marked photo through a smartphone application, categorizing the photo based on repairs needed (striping, sweeping, pothole repair, etc). Reno, Nevada is one example of a municipality engaging its citizens this way in monitoring for maintenance needs.

## Monitoring

This section presents a framework for monitoring the success of implementation of the Plan through benchmarking progress, engaging local advocacy groups, and continuing to generate interest in bicycle and pedestrian issues once a master plan is complete. Evaluation and monitoring allow Saratoga Springs to track progress made as it implements the bicycle and pedestrian master plan. Three major components to monitoring bicycle and pedestrian planning efforts should follow plan adoption:

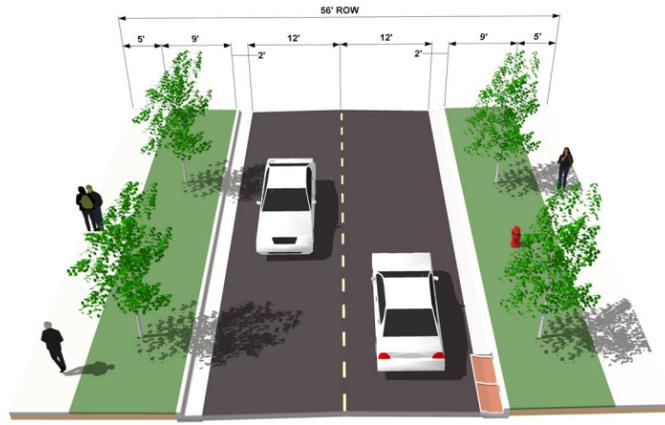
- Tracking progress on implementing planned projects and meeting the master plan’s stated goals;
- Monitoring needs for small-scale spot improvements on bicycle and pedestrian facilities; and
- Monitoring public sentiment and engagement in bicycling and walking issues.

**TABLE 12: MONITORING ACTIVITIES**

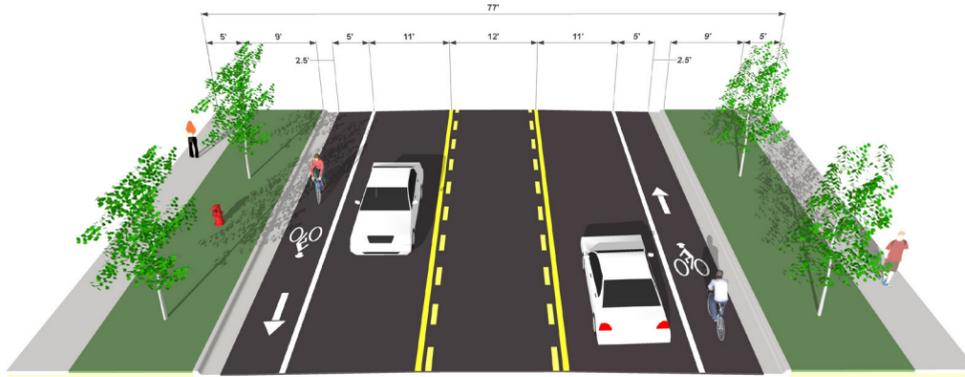
<b>Monitoring Activity</b>	<b>Effort Required</b>
Track plan implementation	Staff time to document projects and policies implemented
Volunteer reporting of maintenance needs	Staff time to receive input and respond to reports
Reactive maintenance	Staff time to respond to maintenance requests
Ongoing Advisory Committee	Staff time to establish policy framework creating an ongoing committee; identify avenue for receiving committee's feedback; and serve as staff liaison at meetings. Committee will set agendas and attend regular meetings.
Ensure project funding through inclusion in Capital Facilities Plan	Staff time to coordinate between planning and budget departments
Proactive maintenance of bicycle and pedestrian facilities	City and/or contractor staff to monitor needs, make needed repairs, plan for funding in municipal public works or operations budgets
Online reporting mechanism for maintenance and repairs	Development of web-based forum to receive public input, staff time to respond to reports
Ongoing local communication around bicycle and pedestrian issues	Maintaining project website, generating new content for website and other communication outlets, developing events to increase participation and enthusiasm, and creating a bicycling ambassadors program
Pursue outside funding for bicycle and pedestrian projects	Staff time to evaluate grant programs, prepare applications, and coordinate with funding agency representatives
Measuring progress by benchmarks	Before-and-after data collection and surveys, review of multiple datasets. Benchmarks could include: <ul style="list-style-type: none"> <li>• Number of people bicycling and walking on off-street facilities</li> <li>• Mileage of on-street bicycle facilities</li> <li>• Percentage of households within ¼ miles of a bicycle facility</li> <li>• Number of pedestrians</li> <li>• Percentage of K-8 students biking and walking to school</li> </ul>
Identify additional financing opportunities for projects, such as public-private partnerships or impact fees	Staff time to build partnerships, and potential need for outside consultant to identify defensible impact fees and ensure compliance with state and local laws.
Regular bicycle and pedestrian counts	Partner with local advocacy groups, boy scouts, schools, and MAG to conduct annual bicycle and pedestrian counts and an annual monitoring program that reviews and compares these counts. Additionally, Saratoga Springs can require that all traffic study counts include bicycles and pedestrians to estimate bicycling levels and changes in bicycling levels over time.
Bicycling and Walking Audits	Conduct bicycle and walking audits as part of outreach strategies for new development projects. A bike/walk audit leads stakeholders on a set course to discuss bicyclist/pedestrian safety concerns and strategies to improve safety.

**Appendix A:**  
**Recommended Cross-Sections**

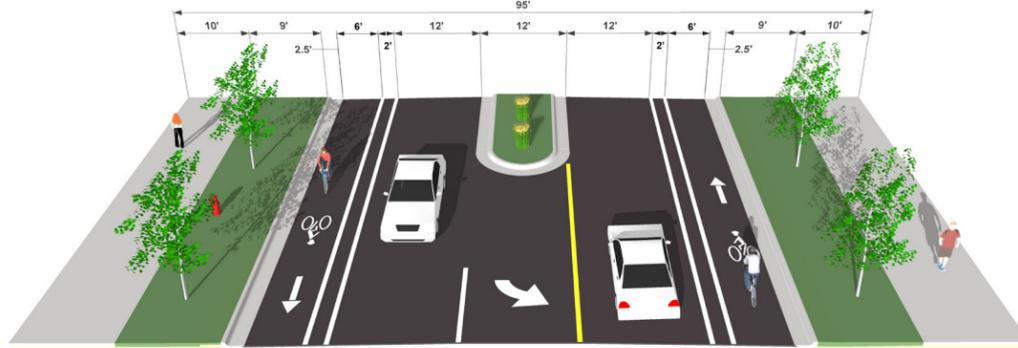
Local Street



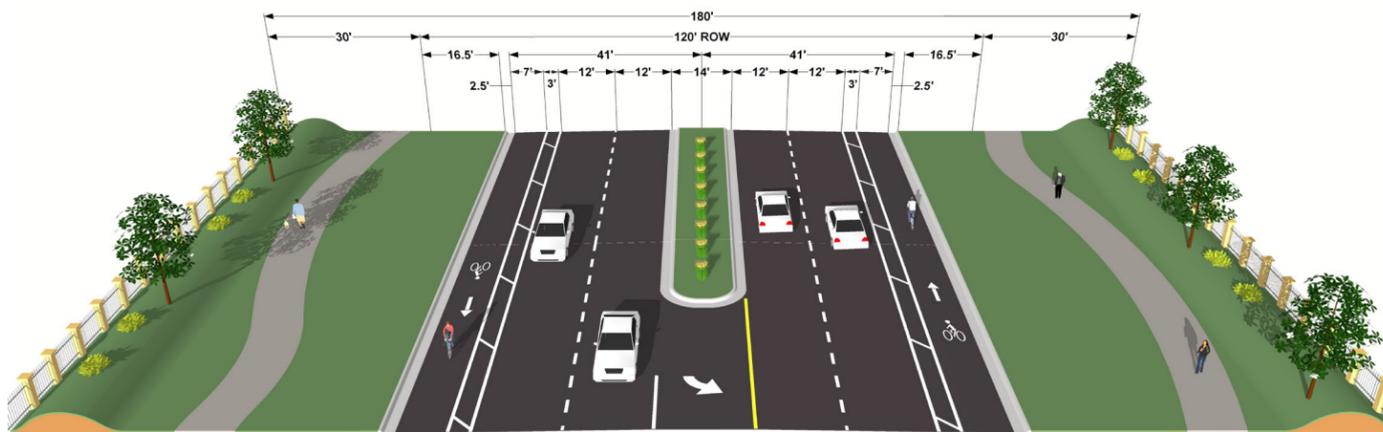
Collector



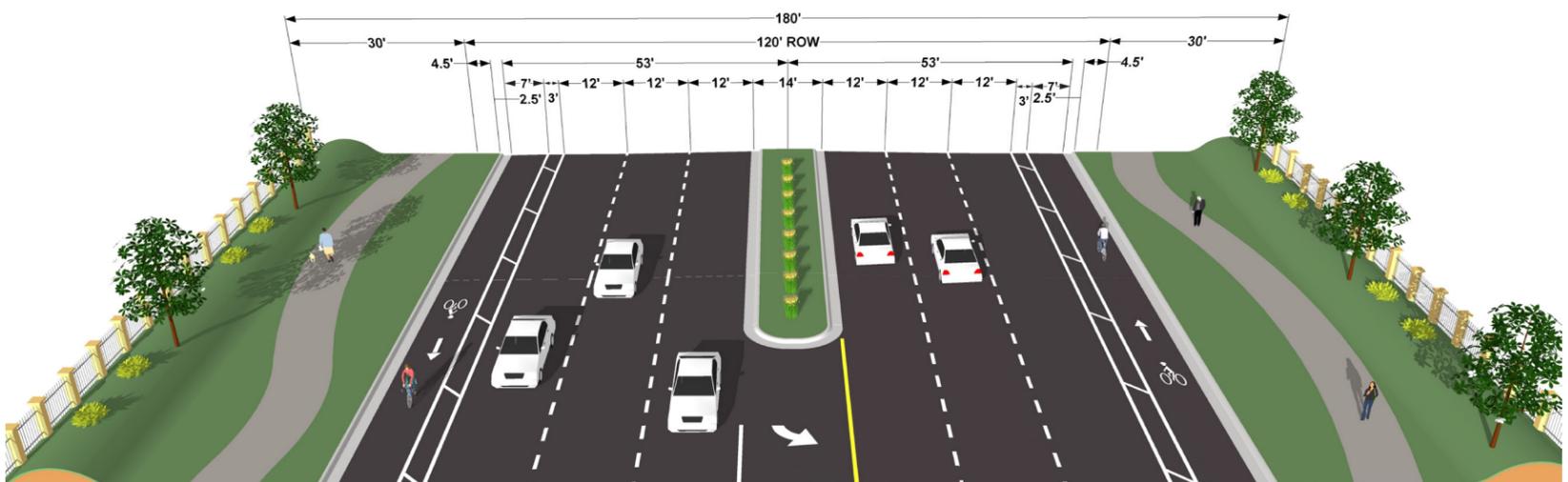
Minor Arterial



Major Arterial



Principal Arterial



**Appendix B:**  
**Bicycle Parking Best Practices**

## Bicycle Parking Best Practices

Bicycle parking is an important end-of-trip facility for those riding bicycles for any purpose, allowing secure storage of bicycles and comfortable access to destinations. The purpose of this documents is to provide Saratoga Springs with best practices in developing a bicycle parking ordinance.

There are many alternatives in how to approach bicycle parking. To develop best practices the Association for Pedestrian and Bicycle Professionals' (APBP) Bicycle Parking Guidelines Manual (2nd Edition) was reviewed as well as code language and design standards from nearby communities like Lindon, Lehi, Orem, South Salt Lake. Portland Oregon, often cited as one of the most bicycle friendly communities in the nation, was also consulted.

### Provide Short and Long-term Bicycle Parking

Providing parking for both short-term users and long-term users is important component in providing adequate bicycle parking for different types of users. Short-term parking in the form of bicycle racks provide a convenient and semi-secure location for visitors who will only be parking for a few hours or less. This encourages bicycle use for utilitarian trips. Long-term parking, in the form of bicycle lockers or indoor bike rooms, provide additional security and protection from weather. This is provided to serve employees and residents who will be parking their bicycles for longer than just a few hours. Providing long-term parking can encourage bicycle use for commute trips.



Short-term parking is typically provided at most land uses, while long-term parking is often required only for multi-family developments and larger employers. For example, in Portland, no long-term bicycle parking is required on a site where there is less than 2,500 square feet of gross building area. As another example, Lehi only requires offices with more than 250 automobile parking stalls to provide long-term bicycle parking storage. Other office users are encouraged to provide long-term bicycle parking, but it is not a requirement. As an incentive, Lehi also offers parking vehicles parking reduction of one vehicle stall for every two indoor bicycle parking stalls up to a 10% reduction in required vehicle stalls.



### Provide an Adequate Amount of Parking for Appropriate Land Uses

Adequate bicycle parking should be provided at most land uses. However, determining the appropriate amount of bicycle parking is a key concern in developing a code. Providing too little will reduce the likelihood of encouraging bicycle use and frustrate users. Providing too much would add additional costs to development with little benefit.

Some cities have elected to use vehicular parking to determine bicycle parking requirements. In this case the total amount is based on a percentage of the total number of required vehicular stalls. As an example, Lehi sets the number of required bicycle stalls at five percent of the total required number of vehicular parking stalls, with a minimum 2 stalls. This applies to all land use types.

The APBP Bicycle Parking Guidelines Manual sets its recommendations based on a bicycle mode share goal of five percent, bicycle ownership rates, and U.S. Green Building Council’s Leadership in Energy Development and Environmental Design (LEED) credit levels for alternative transportation. Different rates are applied based on land use. However, rather than listing out every possible land use, uses are grouped together (see Table 1).

Table 1: Example APBP Bicycle Parking Requirement Recommendations

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
<b>Single Family Homes</b>	No spaces required	No spaces required
<b>Multifamily dwelling</b>		
<b>a. With a private garage</b>	No spaces required	0.10 spaces for each bedroom Minimum of 2 spaces
<b>b. Without a private garage for each unit</b>	0.5 spaces for each bedroom. Minimum of 2 spaces	0.10 spaces for each bedroom. Minimum of 2 spaces
<b>c. Senior Housing</b>	0.5 spaces for each bedroom. Minimum of 2 spaces.	0.10 spaces for each bedroom. Minimum of 2 spaces
<b>Non-assembly cultural (Library, Government Building, etc.)</b>	1.5 spaces for every 10 employees. Minimum of 2 spaces.	1 space for each 8,000 sqft of floor area. Minimum of 2 spaces
<b>Assembly (church, theaters, etc.)</b>	1.5 spaces for every 20 employees. Minimum of 2 spaces.	Spaces for 5% of maximum daily attendance
<b>Health care/hospitals</b>	1.5 spaces for every 20 employees. Minimum of 2 spaces.	1 space for each 20,000 sqft of floor area. Minimum of 2 spaces
<b>Education</b>		
<b>Day-care for 15 or more children</b>	1.5 spaces for each 20 employees or one for each 50,000 sqft of floor area, whichever is greater. Minimum of 2 spaces.	1 space for each 20 students of planned capacity. Minimum of 2 spaces
<b>Nursery schools, kindergartens, and elementary schools (1-3)</b>	1.5 spaces for each 10 employees. Minimum of 2 spaces.	1.5 space for each 20 students of planned capacity. Minimum of 2 spaces
<b>Elementary (4-6), junior high, and high schools</b>	1.5 spaces for each 10 employees plus 1.5 spaces for each 20 students of planned capacity. Minimum of 2 spaces.	1.5 space for each 20 students of planned capacity. Minimum of 2 spaces
<b>Colleges and universities</b>	1.5 spaces for each 10 employees plus 1 space for each	1.5 spaces for each 10 employees plus 1.5 spaces for

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
	10 students of planned capacity; or 1 space for each 20,000 sqft of floor area, whichever is greater.	each 20 students of planned capacity. Minimum of 2 spaces.
<b>Rail/bus terminals and stations/airports</b>	Spaces for 7% of projected a.m. peak period daily ridership	Spaces for 2% of a.m. peak period daily ridership.
<b>Retail (general food sales or groceries)</b>	1 space for each 10,000 sqft. of floor area. Minimum of 2 spaces.	1 space for each 2,000 sqft. of floor area. Minimum of 2 spaces.
<b>General retail</b>	1 space for each 10,000 sqft. of floor area. Minimum of 2 spaces.	1 space for each 5,000 sqft. of floor area. Minimum of 2 spaces.
<b>Office</b>	1.5 spaces for each 10,000 sqft. of floor area. Minimum of 2 spaces.	1 space for each 20,000 sqft. of floor area. Minimum of 2 spaces.
<b>Auto Related</b>	1 space for each 10,000 sqft. of floor area. Minimum of 2 spaces.	1 space for each 20,000 sqft. of floor area. Minimum of 2 spaces.
<b>Off-street parking lots and garages available to the general public</b>	1 space for each 20 automobile spaces. Minimum of 2 spaces.	Minimum of 6 spaces of 1 per 10 auto spaces.
<b>Manufacturing and production</b>	1 space for each 12,000 sqft of floor area. Minimum of 2 spaces	Number of spaces to be prescribed by the Planning Director. Consider minimum of 2 spaces at each public building entrance.

## Parking Location

Short-term bicycle parking should be easy to locate and close to destination entrances. Making bicycle parking highly visible not only helps to encourage bicycle use, but also makes it more secure by ensuring more “eyes on the street”. Distances in the codes reviewed vary between fifty to a hundred feet from building entrances. When possible, short-term parking should also be located in areas that are protected from weather under existing structures.



Long-term bicycle parking should be easy to locate through the use of signage, but should have controlled access. As an example, to provide security, long-term bicycle Portland requires that long-term bicycle parking must be in at least one of the following locations:

- (1) In a locked room;
- (2) In an area that is enclosed by a fence with a locked gate. The fence must be either 8 feet high, or be floor-to-ceiling;
- (3) Within view of an attendant or security guard;
- (4) Within 100 feet of an attendant or security guard;
- (5) In an area that is monitored by a security camera; or
- (6) In an area that is visible from employee work areas.



### Secured to Hard Surface

Short-term bicycle parking should be secured to a hard surface to enhance security and reduce the risk of theft. Hard surfaces also make it easier and more convenient for users to access bicycle parking. This can include concrete or asphalt surfaces.



### Design

The design of bicycle spacing should focus on making parking as easy and convenient as possible for all users. To accommodate a conventional bicycle the following layout design is recommended.

- A bicycle parking space is the space that one bicycle typically occupies (e.g. a U-shaped bicycle rack has two bicycle parking spaces, one on either side of the rack).
- Each required bicycle parking space should be at least 2.5 feet in width (5 feet between parallel racks) by 6 feet in length to allow sufficient space between parked bicycles.
- The rack supports the bicycle frame at two contact points on the frame and allows the bicycle frame and one wheel to be locked to a bicycle rack with a high security, U-shaped shackle lock if both wheels are left on the bicycle.
- A bicycle six feet long can be securely held with its frame supported so that the bicycle cannot be pushed or fall in a manner that will damage the wheels or components.
- The rack should be securely anchored.
- Each bicycle parking space should be accessible without moving another bicycle.
- There should be an aisle **at least** 4 feet wide behind all required bicycle parking to allow room for bicycle maneuvering.
- The area devoted to bicycle parking should be a hard surface.
- Racks should be located with **at least** 30 inches clearance in all directions from any obstruction, including but not limited to other racks, walls, and landscaping. Large retail uses such as supermarkets and grocery stores should be encouraged to locate racks with a 36 inch clearance

in all directions from any vertical obstruction, including but not limited to other racks, walls, and landscaping.

In developing appropriate dimensions, the city should also consider alternative bicycle types that often have different design considerations. Accommodating tandem, recumbent, folding bicycles, adult tricycles, and cargo bicycles should be considered in determining appropriate bicycle parking design. However, this should also be weighed against the additional space and costs of accommodating non-conventional bicycles. The codes that were reviewed did not include designs specifically focused on accommodating different types of bicycles. However, certain land uses like senior living centers and grocery stores may benefit from having different design requirements.



## References

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**Appendix C:**  
**Bike Facility Decision Matrix**

# BICYCLE FACILITY CONTEXTUAL GUIDANCE

AVERAGE ANNUAL DAILY TRAFFIC (1,000 veh/day or 100 veh/peak hr)

## FACILITY TYPE

### NEIGHBORHOOD BIKEWAY

Comfortable and attractive bicycling environment without utilizing physical separation; typically employs techniques to prioritize bicycling.

### ADVISORY BIKE LANE

Bicycle priority areas delineated by dotted white lines, separated from a narrow automobile travel area.

### BIKE LANE

Exclusive space for bicyclists through the use of pavement markings and signage (without buffers or barriers).

### BUFFERED BIKE LANE

Traditional bike lane separated by painted buffer to vehicle travel lanes and/or parking lanes.

### PROTECTED BIKE LANE

Physically separated bikeway. Could be one or two way and protected by a variety of techniques

### SHARED-USE PATH

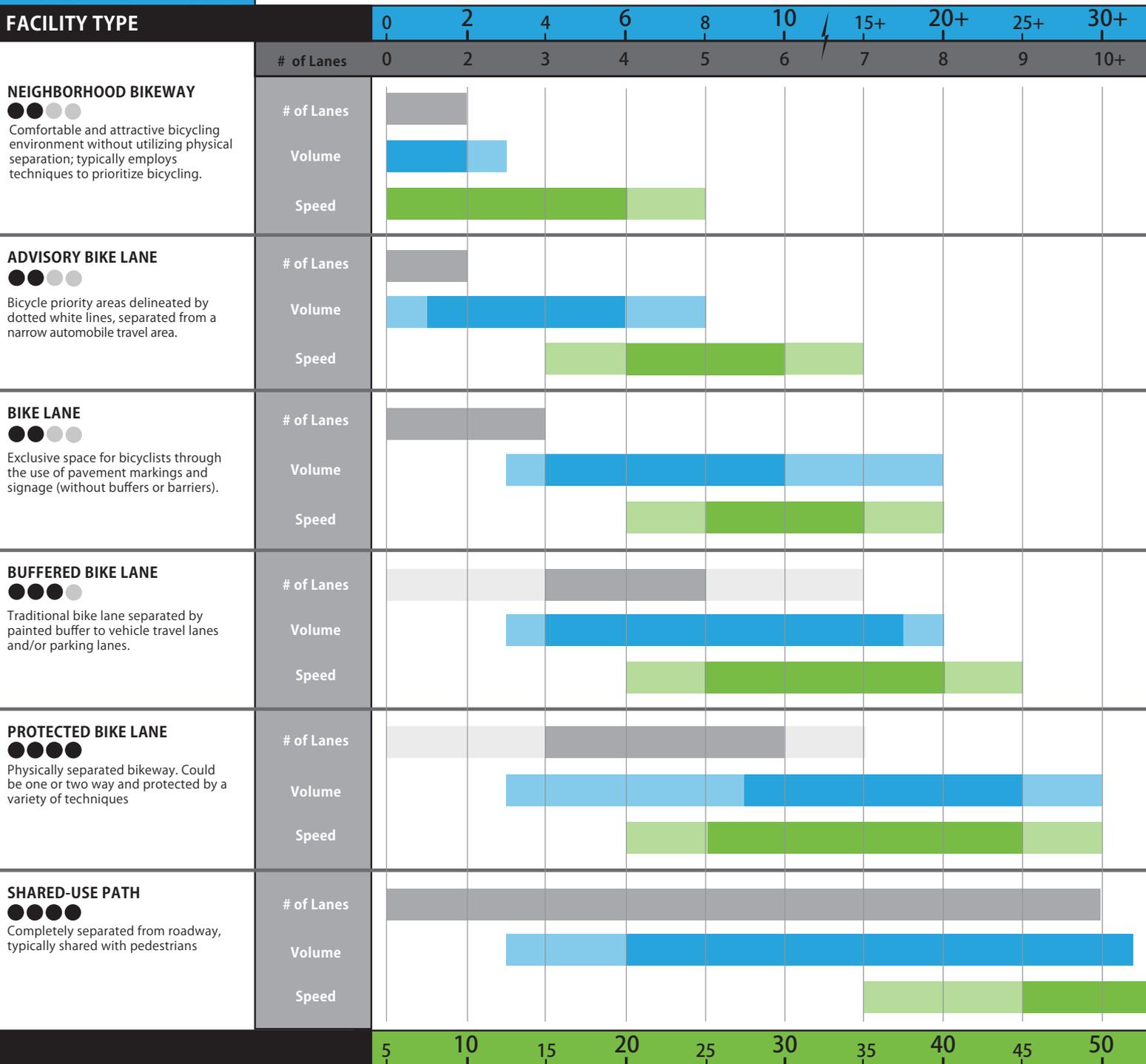
Completely separated from roadway, typically shared with pedestrians

## LEGEND

SEPARATION	
●●●●	Minimal Separation
●●●●●	Moderate Separation
●●●●●●	Good Separation
●●●●●●●	High Separation

min	LANES	max
min	VOLUME	max
min	SPEED	max

Acceptable    Desired    Acceptable



POSTED TRAVEL SPEED (mph)

## **Appendix D:**

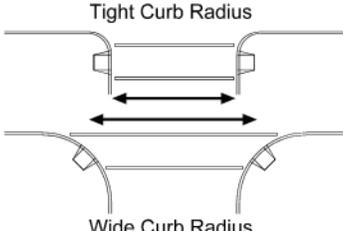
# **Bicycle and Pedestrian Facility Toolbox**

# Bicycle and Pedestrian Facility Toolbox

## Pedestrian Crossing Treatments

Tool	Description	Benefits	Consideration
<p><b>Marked Crosswalk</b></p>  <p><i>Image source: www.walkinginfo.org/pedsafe/</i></p>	<p>Provide designated pedestrian crossings at:</p> <ul style="list-style-type: none"> <li>• Pedestrian generators</li> <li>• Crossings with significant pedestrian volumes (at least 15 per hour)</li> <li>• Crossings with high vehicle-pedestrian collisions</li> </ul>	<p>Signal a clear “channel” for pedestrian pathways to both pedestrians and vehicles</p>	<p>Marked crosswalks alone should not be installed on multi-lane roads with more than about 10,000 vehicles/ day.</p>
<p><b>High-Visibility Signs and Markings</b></p> 	<p>Includes a family of crosswalk striping styles such as the “ladder” and the “continental”</p> <p>High-visibility colored signs are posted at crossings to increase driver awareness of the pedestrian crossing</p>	<p>Increase driver awareness of unexpected condition or location where drivers need to exercise a higher level of caution based on potential conflicts with more vulnerable road users</p>	<p>Beneficial in areas where drivers might not expect a pedestrian crossing or where a higher level of driver attention is required due to potential pedestrian and bicycle conflicts</p>
<p><b>Advanced Yield Lines</b></p>  <p><i>Image source: www.saferoutesinfo.org</i></p>	<p>Standard white yield limit lines are placed in advance of marked, uncontrolled crosswalks.</p>	<p>Increases the pedestrian’s visibility to motorists</p> <p>Reduces the number of vehicles encroaching on the crosswalk</p> <p>Indicates to drivers where to stop</p>	<p>Useful in areas where pedestrian visibility is low and in areas with aggressive drivers</p> <p>Addresses the multiple-threat collision on multi-lane roads.</p>

# Pedestrian Crossing Treatments

Tool	Description	Benefits	Consideration
<p><b>In-Street Pedestrian Crossing Signs</b></p>  <p><i>Image source: <a href="http://mutcd.fhwa.dot.gov">http://mutcd.fhwa.dot.gov</a></i></p>	<p>Regulatory pedestrian signage posted on lane edge lines and road centerlines</p> <p>May be used to remind road users of laws regarding right of way at an unsignalized pedestrian crossing</p>	<p>Highly visible to motorists and has a positive impact on pedestrian safety at crosswalks</p> <p>Good driver compliance with yielding to pedestrians though compliance decreases on multi-lane roadways</p>	<p>Mid-block crosswalks</p> <p>Unsignalized intersections</p> <p>Low-speed areas</p> <p>Two-lane roadways</p> <p>May need to be removed in winter in snowy climates</p>
<p><b>Curb Extension/ Bulb Outs</b></p> 	<p>Traffic-calming measure meant to slow traffic and increase driver awareness</p> <p>Consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider</p>	<p>Narrows the distance that a pedestrian has to cross and decreases pedestrian exposure time</p> <p>Increases the sidewalk space on the corners.</p> <p>Improves pedestrian visibility</p> <p>Lowers vehicle turning speeds</p> <p>Provides opportunity to store and treat storm water runoff</p>	<p>Suitable along most roadways and intersections so long as a parking lane shadows the curb extension</p> <p>Need to consider impact on transit service and could provide extended curb extension that extends length of bus stop so long as there is another travel lane to bypass the stopped bus</p> <p>Need to consider larger vehicle turning paths</p>
<p><b>Reduced Curb Radii</b></p>  <p><i>Image Source: <a href="http://www.ci.austin.tx.us">www.ci.austin.tx.us</a></i></p>	<p>The radius of a curb is reduced requiring motorists to make a tighter turn</p>	<p>Narrow the distance pedestrians have to cross</p> <p>Reduce traffic speeds and increase driver awareness (like curb extensions)</p>	<p>Beneficial on streets with high pedestrian activity, on-street parking, and no curb-edge transit service</p> <p>More suitable for wider roadways and roadways with low volumes of heavy truck traffic</p>

# Pedestrian Crossing Treatments

Tool	Description	Benefits	Consideration
<p><b>Raised Crosswalks</b></p> 	<p>Marked crosswalks that are raised to act simultaneously as a traffic calming device</p>	<p>Provide superior safety advantage to pedestrians with demonstrated increased yielding by drivers</p>	<p>Appropriate on streets with moderate traffic</p> <p>Particularly effective where heavily used trails cross a road</p>
<p><b>Median Pedestrian Island</b></p>  <p><i>Image source: <a href="http://thegoodcity.wordpress.com/category/transportation/">http://thegoodcity.wordpress.com/category/transportation/</a></i></p>	<p>Raised islands are placed in the center of a roadway, separating opposing lanes of traffic with cutouts for accessibility along the pedestrian path, providing a refuge for people crossing</p>	<p>This measure allows pedestrians to focus on each direction of traffic separately, and the refuge provides pedestrians with a better view of oncoming traffic as well as allowing drivers to see pedestrians more easily. It can also split up a multi-lane road and act as a supplement to additional pedestrian tools.</p>	<p>Recommended for multi-lane roads wide enough to accommodate an ADA-accessible median</p>
<p><b>Staggered Median Pedestrian Island</b></p>  <p><i>Image source: <a href="http://www.pedbikeimages.org/">www.pedbikeimages.org/</a></i></p>	<p>Crosswalks in the roadway are staggered such that a pedestrian crosses half the street and then must walk <i>towards</i> traffic to reach the second half of the crosswalk</p> <p>Must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel.</p>	<p>Increase in the concentration of pedestrians at a crossing and the provision of better traffic views for pedestrians</p> <p>Motorists are better able to see pedestrians as they walk through the staggered refuge.</p>	<p>Best used on multi-lane roads with obstructed pedestrian visibility or with off-set intersections</p> <p>Must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel</p>

## Pedestrian Crossing Treatments

Tool	Description	Benefits	Consideration
<p><b>In-Roadway Warning Lights</b></p>  <p><i>Image Source: www.tfhr.gov/</i></p>	<p>Both sides of a crosswalk are lined with pavement markers, often containing an amber LED strobe light</p> <p>Lights may be push-button activated or activated through passive pedestrian detection</p>	<p>Provides a dynamic visual cue</p> <p>Increase effectiveness in low light conditions</p>	<p>Best in locations with low bicycle ridership, as the raised markers present a hazard to bicyclists</p> <p>May not be appropriate in areas with accumulating snow due to decreased visibility of lights</p> <p>Not as effective in locations with bright sunlight</p>
<p><b>Overhead Flashing Beacons</b></p>  <p><i>Image source: tti.tamu.edu</i></p>	<p>Flashing amber lights installed on overhead signs in advance of the crosswalk or at the crosswalk</p>	<p>Blinking lights during pedestrian crossing times increase the number of drivers yielding for pedestrians and reduce pedestrian-vehicle conflicts</p> <p>May also improve conditions on multi-lane roadways.</p>	<p>Best used in places where motorists cannot see a traditional sign due to topography or other barriers</p>
<p><b>Rapid Flash Beacons</b></p>  <p><i>Image source: mutcd.fhwa.dot.gov</i></p>	<p>Replace the traditional slow flashing incandescent lamps with rapid flashing LED lamps</p> <p>The beacons may be push-button activated or activated with pedestrian detection</p>	<p>Very effective as measured by increased driver yielding compliance (65-80% compliance)</p> <p>Solar panels reduce energy costs associated with the device</p> <p>Wireless capabilities reduces installation cost</p>	<p>Appropriate for single and multi-lane roadways</p> <p>Effectiveness decreases as the number of travel lanes increases</p>

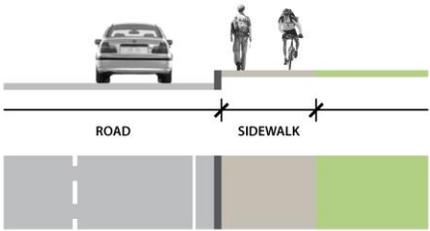
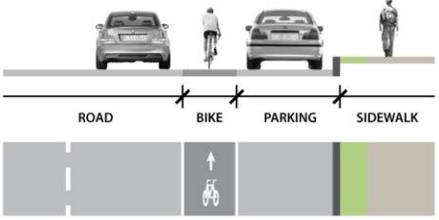
# Pedestrian Crossing Treatments

Tool	Description	Benefits	Consideration
<p><b>Pedestrian Hybrid Beacon</b></p> 	<p>Pedestrian-actuated beacon that is a combination of a beacon flasher and a traffic control signal</p> <p>When actuated, the beacon displays a yellow (warning) indication followed by a solid red light</p> <p>During pedestrian clearance, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark</p>	<p>Reduces pedestrian-vehicle conflicts and increases driver compliance with yielding to pedestrians (80-90% compliance)</p> <p>Reduces vehicle delay when compared to standard pedestrian traffic signal</p>	<p>Useful in areas where it is difficult for pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied</p> <p>Based on higher cost, most appropriate for higher speed multi-lane roadways.</p>
<p><b>Pedestrian Countdown Signals</b></p>  <p><i>Image source: <a href="http://www.livablestreets.com">www.livablestreets.com</a></i></p>	<p>Pedestrian signal head that displays the amount of time remaining during the pedestrian clearance interval</p>	<p>Reduces pedestrian-vehicle conflicts and slows traffic speeds</p> <p>Studies have shown it reduces pedestrian versus vehicular crashes by 25%</p>	<p>Required by the MUTCD for all signalized intersections</p> <p>With pedestrian signal heads</p>

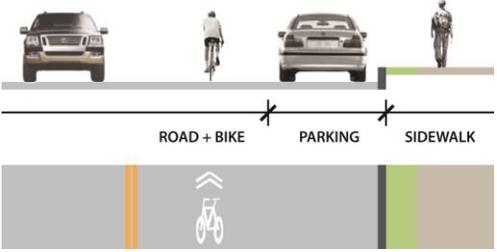
# Pedestrian Corridor Treatments

Tool	Description	Benefits	Consideration
<p><b>Sidewalks</b></p> 	<p>All-weather walking surface outside the travel way</p>	<p>Provides pedestrians a safer and more enjoyable location to walk along a roadway</p>	<p>Should be consider along all corridors</p>
<p><b>Corridor Lighting</b></p>  <p><small>Peter Lagerwey</small></p> <p><i>Image source: <a href="http://www.pedbikeimages.org/">www.pedbikeimages.org/</a></i></p>	<p>Roadway and pedestrian sidewalk lighting to improve driver visibility of pedestrians during low light conditions</p>	<p>Improves driver visibility of pedestrians and provides them more time to react to a potential conflict</p>	<p>Should be considered along all corridors</p>
<p><b>Landscape Buffer</b></p> 	<p>Providing a 5-12' landscaping strip between the edge of roadway and the pedestrian path</p>	<p>Improves pedestrian walking environment by providing buffer between moving traffic and sidewalk</p> <p>Provides area to install street furniture and utilities to help maintain a clear pedestrian walkway</p> <p>Provides an area to store and treat storm water run-off</p>	<p>Should be considered on most corridors where right-of-way width permits</p>

# Bicycle Facility Treatments

Tool	Description	Benefits	Consideration
<p><b>Sidewalk Bikes Permitted</b></p>  <p>The diagram shows a cross-section of a street. On the left is a 'ROAD' with a car. To the right of the road is a 'SIDEWALK' area. A person is walking on the sidewalk, and a person is riding a bicycle on the sidewalk. A physical curb separates the road from the sidewalk. Below the diagram is a color-coded pavement layout: a grey road with a dashed white line, a grey sidewalk, and a green area representing the bicycle lane on the sidewalk.</p>	<p>Designed for bicycle usage to avoid conflicts between single direction motor vehicle traffic</p>	<p>Sidewalks will include additional signage, ground markings, and special curb cuts to facilitate bicycle travel</p> <p>Physical separation between wheeled and non-wheeled users is recommended to minimize potential conflicts between users</p>	<p>Interim solutions that connect two green facilities together</p> <p>Should be used only when there is no immediate solution to resolve a connection between two green facilities</p>
<p><b>Buffered or Protected Bike Lane</b></p>  <p>A photograph of a city street with a green-painted buffered bike lane. The lane is separated from the road by a white curb and a white-painted buffer zone. A fire hydrant is visible on the sidewalk next to the bike lane. In the background, there are modern glass skyscrapers and a white SUV parked on the street.</p>	<p>Created by painting a flush buffer zone between a bike lane and the adjacent travel lane</p> <p>Buffers may also be provided between bike lanes and parking lanes to demarcate the door zone and discourage bicyclists from riding closely next to parked vehicles</p> <p>Buffer zones may be more permanent through the use of concrete barriers, parking, planters, or differences in elevation</p>	<p>Provides a warning for motorists and bicyclists that the street is multi-purpose</p> <p>Buffered bike lanes increase the riding comfort for bicyclists as they increase separation from vehicular traffic and/or parked vehicles</p>	<p>Should be considered at locations where there is excess pavement width or where increased separation is desired</p>
<p><b>Bicycle Lane</b></p>  <p>The diagram shows a cross-section of a street with a dedicated bicycle lane. From left to right: a 'ROAD' with a car, a 'BIKE' lane with a bicycle icon and an arrow pointing forward, a 'PARKING' area with a car, and a 'SIDEWALK' with a person walking. Physical curbs separate the road, bike lane, parking, and sidewalk. Below the diagram is a color-coded pavement layout: a grey road with a dashed white line, a grey bike lane with a white arrow and bicycle icon, a grey parking area, and a green sidewalk.</p>	<p>Portion of the roadway designated for preferential use by bicyclists</p> <p>One-way facilities that typically carry bicycle traffic in the same direction as adjacent motor vehicle traffic on the right side of the roadway</p>	<p>Provide dedicated space from vehicular traffic</p> <p>Reduce stress caused by acceleration and operating speed differentials between bicyclists and motorists</p>	<p>Desirable on collectors and some arterials where traffic volumes and speeds are higher</p> <p>Typically installed by reallocating existing street space by narrowing existing lanes, removing travel lanes or parking lanes, and/or reconfiguring parking lanes</p>

## Bicycle Facility Treatments

Tool	Description	Benefits	Consideration
<p><b>Bicycle Boulevard</b></p>  <p><i>Image source: www.pedbikeimages.org/</i></p>	<p>Low traffic volume and low speed streets that are designated to give cyclists the priority.</p> <p>Use signs, pavement markings, and traffic calming measures to discourage through trips by motor vehicles and provide cyclists with enhanced crossing of arterial streets.</p>	<p>Provide cyclists of all abilities with low stress route</p> <p>Enhanced safety due to reduced exposure to moving traffic</p> <p>Provide enhanced wayfinding</p>	<p>Installed on streets with less than 3000 ADT and travel speeds below 25 mph</p> <p>Install traffic calming to reduce travel speeds or traffic volumes</p> <p>Coordinate with emergency responders on impacts to their response time</p>
<p><b>Marked Shared Lane (Sharrow)</b></p> 	<p>Marking alerts road users to the lateral position bicyclists are likely to occupy within the traveled way to be most visible to drivers and to help avoid conflicts with parked cars</p>	<p>Provide guidance to bicyclists and motorists in situations where separate bicycle facilities are not provided</p> <p>Encourage safer passing practices (including changing lanes, if necessary)</p>	<p>Installed where there is insufficient space to allocate to a dedicated bicycle facility in the right most through travel lane</p> <p>Generally used on collector streets where a more comfortable bicycle facility cannot be provided due to right-of-way constraints</p>
<p><b>Advisory Bike Lane</b></p>  <p><i>Image source: Minneapolis Dept. of Public Works</i></p>	<p>Uses dashed lane line to distinguish bike lane and allow for drivers to encroach into the bike lane when cyclists are not present to avoid an oncoming vehicle in the opposite direction</p>	<p>Brings greater awareness to the roadway as shared space</p> <p>Encourages slower vehicular travel speeds and reduces cut through traffic</p>	<p>Generally used on streets too narrow for traditional bike lanes and lower volume streets</p> <p>Do not impact usable roadway width</p>

# Bicycle Facility Treatments

Tool	Description	Benefits	Consideration
<p><b>Grade Separated Crossing</b></p>  <p><i>Image source: omahamidcenturymodern.blogspot.com</i></p>	<p>Pedestrian-only overpass or underpass over a roadway or topographical barrier</p> <p>Provides complete separation of pedestrians from motor vehicle traffic, normally where no other pedestrian facility is available</p>	<p>Allow for the uninterrupted flow of pedestrian movement separate from vehicular traffic</p> <p>Reduces energy expenditure for cyclists by spanning existing topography</p>	<p>Most feasible and appropriate in extreme cases where pedestrians must cross roadways such as freeways and high-speed, high-volume arterials</p> <p>This measure should be considered only with further study due to the cost implications</p>
<p><b>Back-in Angle Parking</b></p>  <p><i>Image source: www.pedbikeimages.org/</i></p>	<p>Reorients traditional head-in parking to allow drivers to back into a diagonal parking space</p>	<p>Improves driver visibility of approaching traffic and cyclists</p> <p>Improves vehicle passenger safety, especially for children, as open doors of the vehicle block pedestrian access to the travel lane and guide pedestrians to the sidewalk</p> <p>Eases loading of cargo into trunk of vehicle</p>	<p>Highly recommended in locations where diagonal parking is adjacent to bike lane</p> <p>Avoid installing near locations where vehicle overhang could cause damage or danger pedestrians on the sidewalk</p> <p>Sometimes can require outreach to drivers to educate them on the change in parking orientation</p>

## Bicycle Parking & Maintenance

Tool	Description	Benefits	Consideration
<p><b>Bike Rack</b></p> 	<p>Bicycle racks are devices to which bicycles may be securely attached. The rack itself should be securely attached to the ground or a stationary object such as a building. Weather protection may also be provided in the form of a cover or shield. Bike racks are appropriate for short-term use.</p>	<p>Provides bicyclists with short-term parking</p> <p>Encourages bicycle use</p>	<p>Possible risk of bicycle theft or vandalism</p> <p>If racks are not covered, bicycles may be exposed to the elements</p>
<p><b>Bicycle Locker</b></p> 	<p>A locker or box in which a single bicycle can be placed and locked. Lockers may either be available on a first-come-first-served basis and/or for a fee. Users can reserve lockers for several months at a time for an established fee, or can rent as needed on a short-term basis.</p>	<p>Good for long-term use</p> <p>Encourages bicycle use</p> <p>Prevents theft and vandalism</p> <p>Typically provides protection from the elements</p>	<p>More expensive than bike racks</p> <p>Potential to be misused such as for storage of things besides bicycles</p>
<p><b>Bicycle Repair Stands</b></p> 	<p>Do-it-yourself bicycle repair stands offer an air pump and basic tools to make minor bicycle repairs.</p>	<p>Encourages bicycle use by removing concerns related to common maintenance and repair issues.</p>	<p>Repair stands should be located near short-term and long-term bicycle parking.</p>

# Bicycle Facility Intersection Treatments

Tool	Description	Benefits	Consideration
<p><b>Enhanced Intersection Markings</b></p>  <p><i>Image source: NACTO</i></p>	<p>Consists of using colored pavement markings or additional bike symbols within the intersection to increase the visibility of cyclists to drivers, identify areas of potential conflict, and provide guidance to cyclists on their intended alignment through the intersection.</p>	<p>Increases visibility of cyclists</p> <p>Raises driver and cyclists awareness of conflict areas</p> <p>Increases driver yielding behavior</p> <p>Increases cyclists comfort level</p>	<p>Should be used reluctantly in area where there is potential for conflict between cyclists and drivers</p> <p>Typical application locations include across wide intersections and driveways and along enhanced bikeway facilities</p>
<p><b>Bicycle Box</b></p> 	<p>A bicycle box is a marked on-street waiting area designed to improve cyclist visibility when stopped. There are two types of bicycle boxes: two-point left turn and advanced stop line.</p>	<p>Cyclists are more visible to automobiles and not forced to wait within traffic</p> <p>Cyclists may be allowed to travel in directions that automobiles are not</p>	<p>Drivers and other cyclists may not be aware of how bike boxes function</p> <p>The two-point left may take more time to cross the intersection</p> <p>Traffic level of service may be affected by advanced stop line bike boxes</p>
<p><b>Bicycle Detection Loop</b></p> 	<p>Embedded loop detector in roadway surface detects a bicycle</p>	<p>Decreases delay for cyclists at signalized intersection</p> <p>Encourages cyclists to wait for signal indication</p>	<p>Should be considered in locations where there is a high number of cyclists or low number of vehicles that would activate the signal</p>

## Bicycle Facility Intersection Treatments

Tool	Description	Benefits	Consideration
<p><b>Bicycle Signal</b></p> 	<p>Signals dictate traffic behaviors and patterns. Bicycle signals give priority phasing for bicycle crossing. They can also inform cyclists and drivers about the interaction between bicycles and traffic.</p>	<p>Improves safety by allowing cyclists to cross intersection without interacting with automobiles</p> <p>Traffic signals are understood by cyclists and drivers</p> <p>Opportunity to combine phasing with crosswalks</p>	<p>Added cost</p> <p>Possible negative impacts to intersection level of service</p>

## Signalized Intersection Treatments

Tool	Description	Benefits	Consideration
<p><b>Leading Pedestrian/Bicycle Intervals</b></p> 	<p>Traffic signal timing that provides pedestrians/bicyclists with a few second head start prior to motor vehicles on the parallel roadway being given the green light</p>	<p>Increases pedestrian visibility for turning vehicles and driver yielding compliance for pedestrians</p> <p>Helps reduce conflicts between turning vehicles and pedestrians</p>	<p>Can be applied at most signalized intersections especially where there is a high number of turning vehicles and pedestrians conflicts</p>
<p><b>Protected Left Turn Phasing</b></p> 	<p>Traffic signal phasing that only allows left turning vehicles to enter the intersection</p>	<p>Eliminates conflicts between left turning vehicles and pedestrians which is one of the most common type of crash involving a pedestrian and vehicle</p>	<p>Used primarily on higher volume roadways where the left turning vehicle must cross multiple approach lanes and there is no left turn storage issues</p>
<p><b>No Turn on Red (signs)</b></p> 	<p>Posting regulatory signs that restrict vehicles from turning on red signal indications</p>	<p>Eliminates potential conflicts between turning vehicles and pedestrians or bicyclists that might be crossing during the conflicting traffic signal phase.</p>	<p>Should be considered in most urban locations where there are a high number of pedestrians</p> <p>Turn restriction can be limited to certain hours when pedestrians are most likely to be present at the intersection</p>
<p><b>Retiming Clearance Intervals</b></p>	<p>Modifying the pedestrian clearance intervals at</p>	<p>Increases the comfort level for all pedestrians</p>	<p>Should be considered around schools and senior centers where</p>

	<p>signalized intersections to provide adequate time for a pedestrian to cross the intersection at a slower walking speed that 3.5 ft/s</p>	<p>and reduces the need to rush to cross the street</p>	<p>pedestrians with slower walking speeds are anticipated</p>
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## Bicycle Corridor Signing Treatments

Tool	Description	Benefits	Consideration
<p><b>Way-finding signs</b></p> <p><i>Image source: NACTO</i></p>	<p>Posting a series of pedestrian and bicycle way-finding signs that orient pedestrians to walking and biking destinations along a corridor</p>	<p>Encourages more walking and bike trips by providing people with a reference point to a destination</p>	<p>Applied in locations where there are pedestrian and bicycle destination or attractors</p> <p>Should be located in areas where will not obstruct the pedestrian walkway or create sign clutter</p> <p>Should be scaled to be legible for appropriate user</p> <p>Should not be used to promote private businesses</p>
<p><b>Stop Sign Reorientation</b></p> <p>Turning stop signs to favor through movements on bike blvd.</p>	<p>Reorientating two-way stop controlled approaches to provide bike boulevard approaches with the right-of-way at the intersection</p>	<p>Reduces delay and energy expenditure for cyclists and thereby encourages more cyclists to use the street</p>	<p>Should perform stop warrants analysis prior to removing</p> <p>Repeal existing city ordinances prior to implementation</p> <p>May need to provide additional traffic calming on bike boulevard to discourage additional cut-through traffic and higher travel speeds</p> <p>Should evaluate traffic operation impacts on stop controlled approaches</p>

# Traffic Calming Treatments

Tool	Description	Benefits	Consideration
<p><b>Median Barriers</b></p>  <p><i>Image source: <a href="http://streetswiki.wikispaces.com/Traffic+Diverters">http://streetswiki.wikispaces.com/Traffic+Diverters</a></i></p>	<p>Islands located along the centerline of a street and continuing through an intersection so as to block through movement at a cross street.</p>	<p>Can improve safety by prohibiting dangerous turning movements</p> <p>Can reduce traffic volumes on a cut-through route that crosses a major street</p>	<p>Good for local street connections to main streets where through traffic along the continuing local street is a problem and main streets where left-turns to and/or from the side street are unsafe.</p> <p>Require available street width on the major street</p>
<p><b>Speed Humps (Sinusoidal)</b></p> 	<p>Rounded, raised areas placed across the roadway. They are generally as wide as the lane or roadway and are 10 to 14 feet long (in the direction of travel).</p>	<p>Relatively inexpensive</p> <p>Relatively easy for bicycles to cross</p> <p>Effective in slowing speeds</p>	<p>Good for locations where very low speeds are desired and reasonable, and where noise and fumes are not a major concern.</p> <p>Commonly applied in residential areas with low traffic volumes.</p> <p>Smoother than traditional speed humps</p>
<p><b>Speed Lumps/Speed Cushions</b></p>  <p><i>Image source <a href="http://www.mesaaz.gov/speed/speedFAQ.aspx">www.mesaaz.gov/speed/speedFAQ.aspx</a></i></p>	<p>Several small speed humps installed in a series across a roadway with spaces in between them.</p>	<p>Allow larger vehicles, especially fire trucks, to straddle them without slowing down</p> <p>Bicyclists may pass between speed cushions</p>	<p>Cushions should be clearly marked for visibility.</p>

## Traffic Calming Treatments

Tool	Description	Benefits	Consideration
<p><b>Speed Tables</b></p> 	<p>Flat-topped speed humps often constructed with brick or other textured materials on the flat section. Their long flat designs allow higher speeds than Speed Humps. Textured materials improve the appearance of speed tables, and draw attention to them.</p>	<p>Smoother for large vehicles</p>	<p>Good for locations where low speeds are desired but a somewhat smooth ride is needed for larger vehicles.</p>
<p><b>Raised Crosswalks</b></p> 	<p>Speed Tables outfitted with crosswalk markings and signage to facilitate pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists.</p>	<p>Provide safer crossing for pedestrians  Channelize pedestrians to an attractive crossing</p>	<p>Good for locations where vehicle speeds are excessive and pedestrian volumes are high.  Impacts on drainage need to be considered.</p>
<p><b>Raised Intersections</b></p>  <p><i>Image source: <a href="http://www/transitutopia.blogspot.com">www/transitutopia.blogspot.com</a></i></p>	<p>Flat raised areas covering an entire intersection, with ramps on all approaches and often textured materials. The raised intersection makes crosswalks more visible by motorists and perceived as "pedestrian territory".</p>	<p>Increases awareness of pedestrians  May be used as a neighborhood gateway feature  Calm two streets at once</p>	<p>Good for intersections with substantial pedestrian activity.</p>

# Traffic Calming Treatments

Tool	Description	Benefits	Consideration
<p><b>Traffic Circles</b></p> 	<p>Traffic circles are small roundabouts, with raised islands. Traffic circulates around the central island.</p>	<p>Can reduce crash frequency and severity</p> <p>Can have positive aesthetic value</p> <p>Placed at an intersection, they can calm two streets at once</p>	<p>Good for calming residential or local intersections, where large vehicles are not a major concern but speeds, volumes, and safety are problems.</p> <p>May require elimination of some on-street parking</p> <p>Island landscaping must be maintained</p>
<p><b>Mini Roundabouts</b></p> 	<p>Operate in the same manner as larger roundabouts, with yield control on all entries and counterclockwise circulation around a mountable (traversable) central island.</p>	<p>Can often be developed to fit within existing right-of-way constraints.</p> <p>May provide less delay for a critical movement or for an overall intersection in comparison to other intersection alternatives.</p> <p>Do not allow opportunities for landscaping in the central island. As with comparably sized traditional intersections, landscaping opportunities are limited to the periphery of the intersection.</p>	<p>Most effective in lower speed environments in which all approaching roadways have posted speed of 30 mph or less</p> <p>Generally not recommended for intersections with more than four legs.</p>
<p><b>Center Island Narrowings</b></p>  <p><i>Image source: <a href="http://www.encinoparkhoa.org">www.encinoparkhoa.org</a></i></p>	<p>An island located along the centerline of a street that narrows the travel lanes. They are often landscaped to increase visibility and provide a visual amenity. If fitted with a gap to allow pedestrians to walk through at a crosswalk, they then called "pedestrian refuges."</p>	<p>Increase pedestrian safety</p> <p>Can have positive aesthetic value</p>	<p>Ideal for entrances to residential areas, and wide streets where pedestrians need to cross.</p>

## Traffic Calming Treatments

Tool	Description	Benefits	Consideration
<p><b>Choker/Neckdowns</b></p>  <p><i>Image source: <a href="http://www.pedbikeimages.org/">www.pedbikeimages.org/</a></i></p>	<p>Curb extensions at midblock locations that narrow a street.</p> <p>Can be designed to restrict traffic to a single lane or accommodate two traffic lanes</p>	<p>Easily negotiable by large vehicles</p> <p>Can have positive aesthetic value</p> <p>Shortens pedestrian crossing distance</p>	<p>Good for areas with substantial speed problems and no on-street parking shortage.</p>
<p><b>Center Island Narrowings</b></p>  <p><i><a href="http://www.encinoparkhoa.org">http://www.encinoparkhoa.org</a></i></p>	<p>An island located along the centerline of a street that narrows the travel lanes. They are often landscaped to increase visibility and provide a visual amenity. If Fitted with a gap to allow pedestrians to walk through at a crosswalk, they then called "pedestrian refuges."</p>	<p>Increase pedestrian safety</p> <p>Can have positive aesthetic value</p>	<p>Ideal for entrances to residential areas, and wide streets where pedestrians need to cross.</p>
<p><b>Detached Curb Extensions</b></p> 	<p>Bulb outs that are separated from the curb.</p>	<p>Allow original curb and gutter to drain excess stormwater, but provide benefits of bulb outs.</p> <p>Can be hardscaped or landscaped, including LID.</p>	<p>Not accessible without a cover to bridge the gutter.</p>

**Appendix E:**  
**Crosswalk Decision Matrix**

**PEDESTRIAN CROSSING  
CONTEXTUAL GUIDANCE**  
At unsignalized locations

**Local Streets**  
≤30 mph

**Collector Streets**  
25-45 mph

**Arterial Streets / Parkway**  
45+ mph

FACILITY TYPE	Local Streets		Collector Streets			Arterial Streets / Parkway				
	2 lane		2 lane	2 lane with median refuge		4 lane	4 lane with median refuge	5 lane	6 lane	6 lane with median refuge
Crosswalk Only (high visibility)	✓		EJ	EJ		X	X	X	X	X
Crosswalk with warning signage and yield lines	EJ		✓	✓		X	X	X	X	X
Active Warning Beacon (RRFB)	X		✓	✓		X	✓	X	X	X
Hybrid Beacon	X		EJ	EJ		✓	✓	✓	✓	✓
Full Traffic Signal	X		EJ	EJ		✓	✓	✓	✓	✓
Grade separation	X		EJ	EJ		EJ	EJ	EJ	✓	✓

**LEGEND**

Most Desirable	✓
Engineering Judgement	EJ
Not Recommended	X

**Appendix F:**  
**Separated Bikeways at Intersections**  
**Guidance**

# Separated Bikeways at Intersections

Intersections are junctions at which different modes of transportation meet and facilities overlap. An intersection facilitates the interchange between bicyclists, motorists, pedestrians and other modes in order to advance traffic flow in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable road users) and vehicles by heightening the level of visibility, denoting clear right-of-way and facilitating eye contact and awareness with other modes. Intersection treatments can improve both queuing and merging maneuvers for bicyclists, and are often coordinated with timed or specialized signals.

The configuration of a safe intersection for bicyclists may include elements such as color, signage, medians, signal detection and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian and motorist movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting, and the adjacent street function and land use.



# Bike Lanes at Right Turn Only Lanes

## Description

The appropriate treatment at right-turn lanes is to place the bike lane between the right-turn lane and the right-most through lane or, where right-of-way is insufficient, to use a shared bike lane/turn lane.

The design (right) illustrates a through bike lane, with signage indicating that motorists should yield to bicyclists through the conflict area.

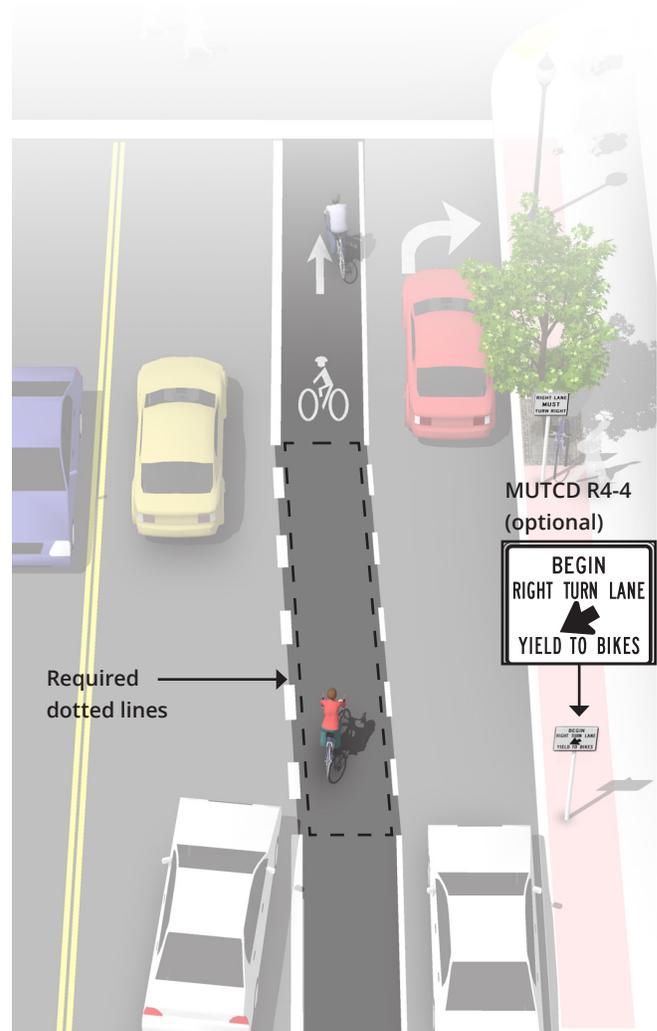
## Guidance

### At auxiliary right turn only lanes (add lane):

- Continue existing bike lane width; 5' min.
- Use signage to indicate that motorists should yield to bicyclists through the merge area.
- Keep merge area as straight as possible to not add confusion about right of way to motorists. If a buffered bike lane is approaching an intersection the bike lane may need to be shifted to the left side of the buffer to create a straight merge area.

### Where a through lane becomes a right turn only lane:

- Do not define a dotted line merging path for bicyclists.
- Drop the bicycle lane in advance of the merge area.
- Use shared lane markings to indicate shared-use of the lane in the merging zone.



## Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*, 2012.  
FHWA. *Manual on Uniform Traffic Control Devices*, 2009.  
NACTO. *Urban Bikeway Design Guide*, 2012.

# Combined Bike Lane / Turn Lane

## Description

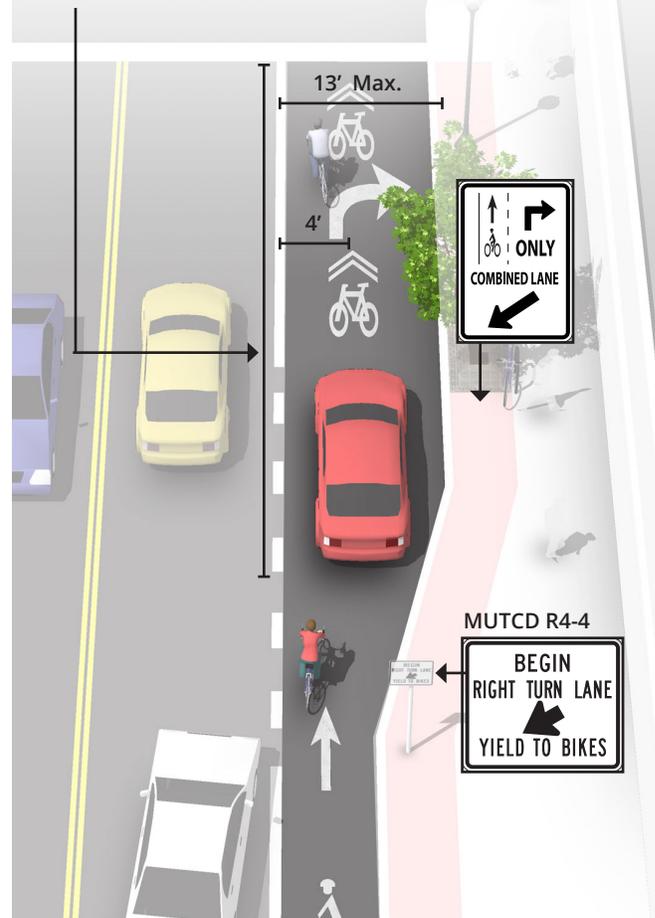
The combined bike lane/turn lane places a standard-width bike lane on the left side of a dedicated right turn lane. Shared lane markings indicate proper bicyclist position within the lane. This treatment includes signage advising motorists and bicyclists of proper positioning within the lane.

This treatment is recommended at intersections lacking sufficient space to accommodate both a standard through bike lane and right turn lane.

## Guidance

- Maximum shared turn lane width is 13 feet; narrower is preferable. If turn lane is greater than 14', provide a dedicated through bicycle lane, see page 11.
- Center shared lane markings 4' from the left edge of the combined turn lane
- Bike lane pocket should have a minimum width of 4 feet with 5 feet preferred.
- A "Right Turn Only" sign with an "Except Bicycles" plaque should be included to make it legal for through bicyclists to use a right turn lane.
- Entrance taper of 1:7 should accommodate 20 mph entry
- Storage length should be less than 100'

Short turn lanes encourage slower motor vehicle speeds



## Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*, 2012.  
FHWA. *Manual on Uniform Traffic Control Devices*, 2009.  
NACTO. *Urban Bikeway Design Guide*, 2012.

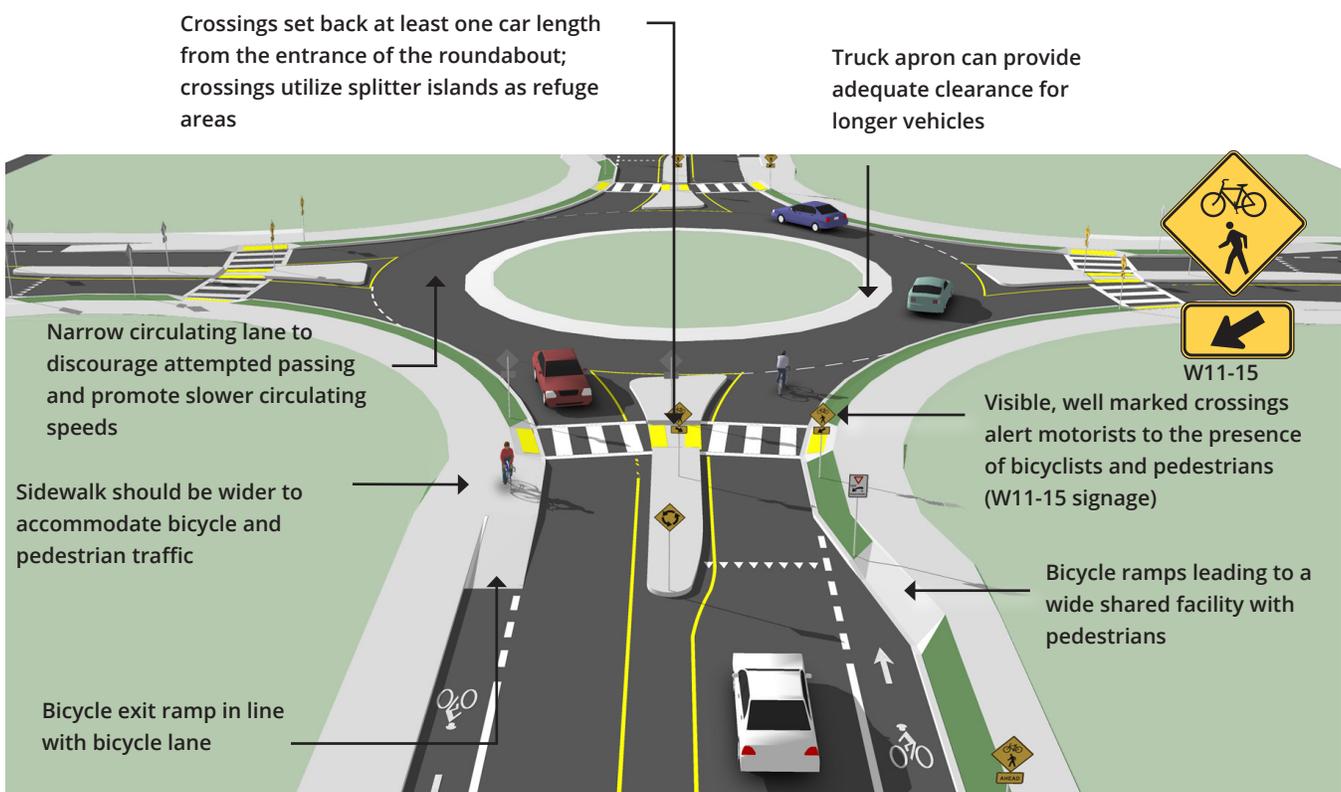
# Single Lane Roundabouts

## Description

In single lane roundabouts it is important to indicate to motorists, bicyclists and pedestrians the right-of-way rules and correct way for them to circulate, using appropriately designed signage, pavement markings, and geometric design elements.

## Guidance

- 25 mph maximum circulating design speed.
- Design approaches/exits to the lowest speeds possible.
- Encourage bicyclists navigating the roundabout like motor vehicles to “take the lane.”
- Maximize yielding rate of motorists to pedestrians and bicyclists at crosswalks.
- Provide separated facilities for bicyclists who prefer not to navigate the roundabout on the roadway.



## Discussion

Research indicates that while single-lane roundabouts may benefit bicyclists and pedestrians by slowing traffic, multi-lane roundabouts may present greater challenges and significantly increase safety problems for these users.

## Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*, 2012.  
FHWA. *Manual on Uniform Traffic Control Devices*, 2009.  
TRB. *Roundabouts: An Informational Guide, Second Edition*. NCHRP 672, 2010.

## Materials and Maintenance

Signage and striping require routine maintenance.

# Bicycle Detection and Actuation

## Description

Bicycle detection at signals promotes safe and legal bicycling behavior by reducing the probability that people riding bicycles will not be detected.

## Guidance

Provide one of the following types of bicycle detection systems at all proposed signals. Include MUTCD Figure 9C-7 to orient bicyclists to proper positioning to facilitate detection.

### Loop Detectors

Bicycle-activated loop detectors are installed within the roadway to allow the presence of a bicycle to trigger a change in the traffic signal.

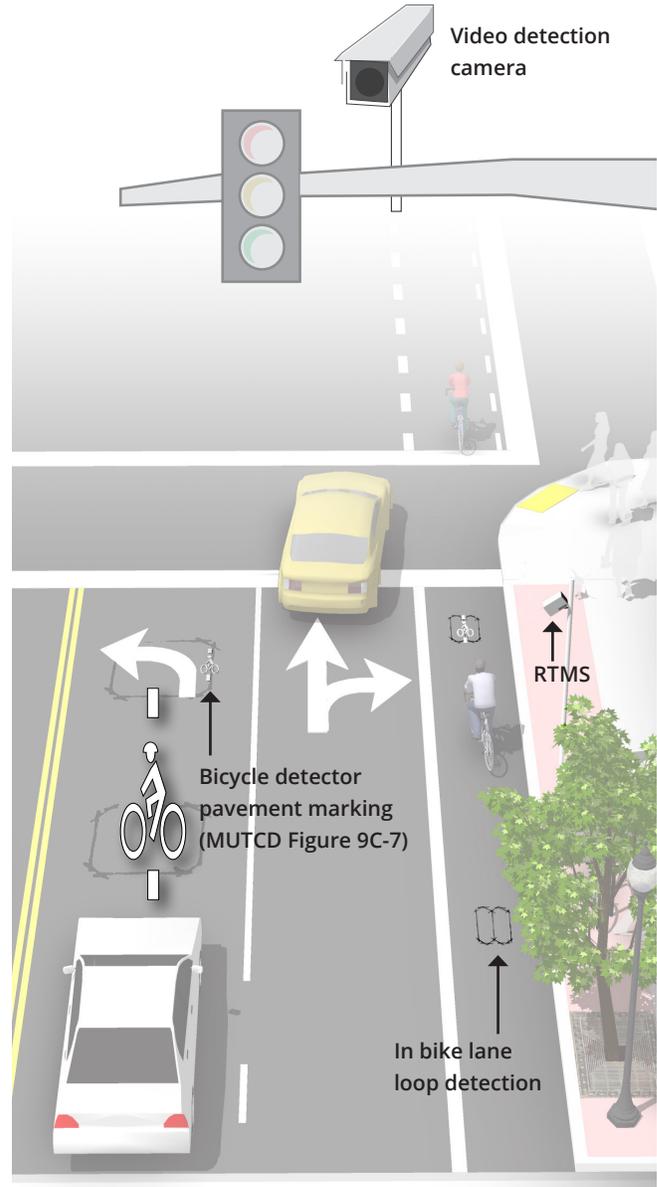
Loops that are sensitive enough to detect bicycles should be supplemented with pavement markings to instruct bicyclists how to trip them.

### Video Detection Cameras

Video detection systems use digital image processing to detect a change in the image at a location.

### Remote Traffic Microwave Sensor Detection (RTMS)

RTMS is a system which uses frequency modulated continuous wave radio signals to detect objects in the roadway. This method marks the detected object with a time code to determine its distance from the sensor. The RTMS system is unaffected by temperature and lighting, which can affect standard video detection.



## Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*, 2012.  
FHWA. *Manual on Uniform Traffic Control Devices*, 2009.  
NACTO. *Urban Bikeway Design Guide*, 2012.

## Materials and Maintenance

Signal detection and actuation for bicyclists should be maintained with other traffic signal detection and roadway pavement markings.

# Two-Stage Turn Queue Boxes

## Description

Two-stage turn queue boxes offer bicyclists a safe way to make left turns at multi-lane signalized intersections from a physically separated or conventional bike lane.

Additionally, bicyclists in protected (or separated) bike lanes are often unable to merge into traffic to turn left due to physical separation, making the provision of two-stage left turn boxes critical.

## Guidance

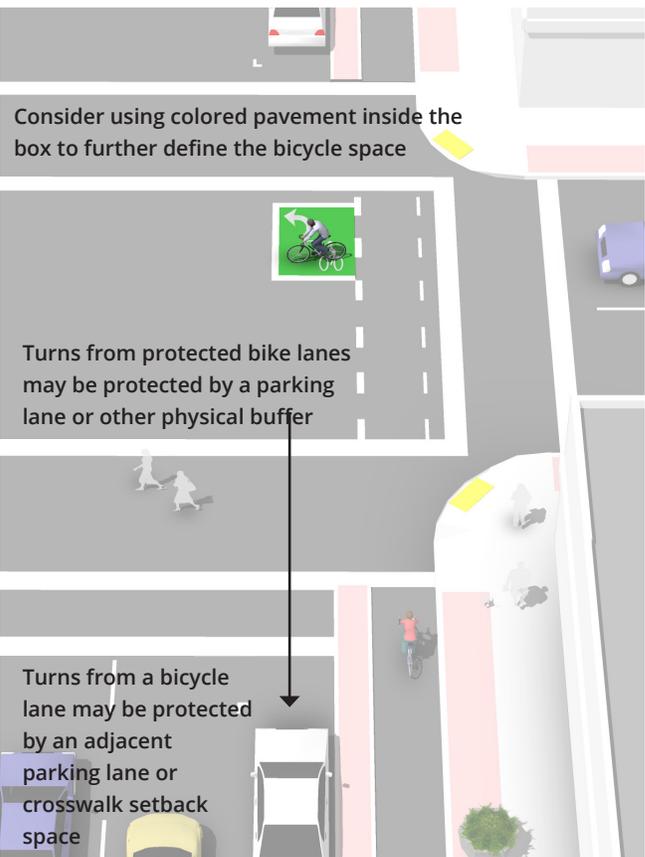
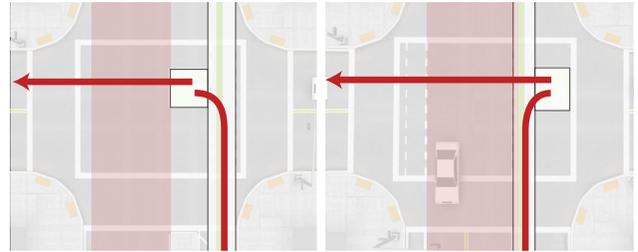
- The queue box shall be placed in a protected area. Typically this is within an on-street parking lane or protected bike lane buffer area.
- 8 foot x 6 foot preferred dimensions of bicycle storage area (6 foot x 3 foot minimum).
- Bicycle stencil and turn arrow pavement markings are used to indicate proper bicycle direction and positioning.
- This design formalizes a maneuver called a “box turn” or “pedestrian style turn”.
- Two-stage turn queue boxes reduce conflicts in multiple ways; from keeping bicyclists from queuing in a bike lane or crosswalk and by separating turning bicyclists from through bicyclists.
- Bicyclist capacity of a two-stage turn queue box is influenced by physical dimension (how many bicyclists it can contain) and signal phasing (how frequently the box clears).
- Consider providing a “No Turn on Red” (MUTCD R10-11) on the cross street to prevent motor vehicles from entering the turn box.

## Discussion

Two-stage turn queue boxes are considered experimental by FHWA. While two stage turns may increase bicyclist comfort in many locations, this configuration will typically result in higher average signal delay for bicyclists due to the need to receive two separate green signal indications (one for the through street, followed by one for the cross street) before proceeding.

Protected bike lane turn box  
protected by physical buffer:

Bike lane turn box  
protected by parking lane:



## Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*, 2012.

## Materials and Maintenance

Paint or other marking materials can wear more quickly in high traffic areas or in winter climates. Costs will vary due to the type of paint used and the size of the two-stage turn box. Typical costs are \$11.50 per square foot.