

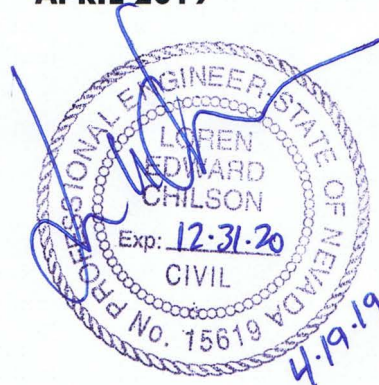


**REGIONAL
TRANSPORTATION
COMMISSION**
OF WASHOE COUNTY, NEVADA



Bicycle Facility Alternatives Analysis for Center, Sierra, and Virginia Streets

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INTRODUCTION

With adoption of the 2017 Bicycle and Pedestrian Master Plan, the Regional Transportation Commission of Washoe County provided a blueprint for creating safer, more connected bicycle and pedestrian facilities throughout the Truckee Meadows region. The plan identifies gaps in the existing network, and prioritizes projects to connect existing and new facilities. Among those projects identified as high priority are the construction of bike facilities on Center, Sierra, and Virginia Streets. Additionally, both Center and Sierra Streets were identified in the Complete Street Master Plan as candidates for Complete Streets design treatments and are included in the first 5 years of the 2017-2040 Regional Transportation Plan. The need for bike facilities through the University, Downtown, and Midtown areas has been reiterated by the community through the recent Virginia Street corridor design process. There are currently no dedicated bike facilities on Center, Sierra, or Virginia Streets through the downtown corridor. Existing conditions are shown in **Attachment B**.

As demonstrated in **Figure 1**, the existing downtown Reno area lacks a strong north-south route for bicyclists. In particular, there is no direct bicycle connection between the growing University of Nevada, Reno campus through downtown Reno and to the vibrant Midtown District to the south.

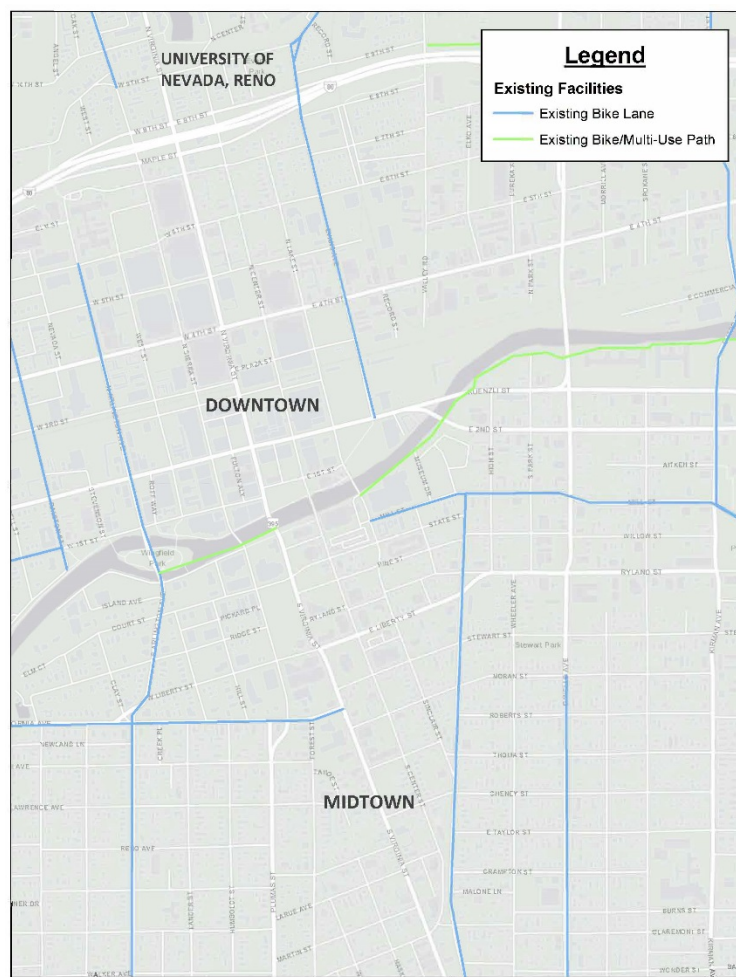


Figure 1: Existing Bicycle Facilities in Downtown Reno

Recognizing the need for dedicated bicycle facilities connecting UNR with Midtown, RTC Washoe developed four alternatives on Center, Sierra, and Virginia Streets for evaluation. These alternatives are:

1. A two-way cycle track on Center Street from S. Virginia Street (at Mary Street) to 9th Street.
2. A northbound bike lane on Center Street from S. Virginia Street (at Mary Street) to 9th Street AND a southbound bike lane on Sierra Street from 9th Street to California Avenue.
3. A one-way cycle track northbound on Center Street from S. Virginia Street (at Mary Street) to 9th Street AND a one-way cycle track southbound on Sierra Street from 9th Street to California Avenue.
4. A center-running two-way cycle track on Virginia Street from 9th Street to Liberty Streets.

This report presents the evaluation of these alternatives to determine project feasibility, estimated costs, and the overall best option for a high-quality north-south downtown connection.

METHODOLOGY

The analysis was conducted in two stages: alternative development and alternative evaluation. Alternatives were developed by considering the fit within the existing pavement, availability of on-street parking, traffic operations, and overall contextual fit. If the developed alternative was considered feasible, additional parameters were evaluated including cost of construction, maintenance factors, quality of connections, and level of traffic stress.

Alternative Development

Fit Within Existing Pavement

To evaluate feasibility, the study team first identified how each alternative would fit within the existing pavement width of the roadway. The narrowing of existing sidewalks and landscape strips was not considered, except for unique locations. Using the existing curb to curb width of the roadway and minimum acceptable lane widths, the team first determined if the alternative could be implemented by only narrowing existing lane widths. If this was not achievable, the removal of parking or travel lanes was then considered.

Parking and Traffic Operations

To determine whether on-street parking could reasonably be removed to provide a bicycle facility, several factors were considered. First, is the existing parking highly utilized? Second, are alternate parking options available? Third, how many spaces would need to be removed?

This study recommends that parking should not be removed in areas where parking is well-utilized, no other parking is available, and where implementing the bike facility would require an unacceptably large number of spaces to be removed.

Where the removal of on-street parking is not feasible, reducing the number of vehicle travel lanes may be a better option to accommodate the bicycle facility. This is not feasible on Virginia Street, but many segments of Sierra and Center Streets have two or three travel lanes in the same direction. To determine if reducing the number of travel lanes would still allow for acceptable traffic flow well into the future, projected traffic volumes for the horizon year 2040 were considered in this analysis.

The 2040 segment volumes were calculated by obtaining recent year (2015) volumes from the Nevada Department of Transportation and applying growth rates indicated by RTC Washoe's Travel Demand Model for the horizon year 2040. Peak hour volumes were assumed to be 10% of total average annual daily traffic (AADT). For this planning level evaluation, the maximum acceptable number of vehicles per hour per lane is 900. The reasonableness of reducing the number of travel lanes was checked by comparing the 2040 peak hour volume against the per lane capacity threshold.

Contextual Fit

On one-way streets like Center and Sierra Streets, bicycle facilities may be located on either the left or right side of the street. For this study, one side or the other was identified as preferable based on the number of turning vehicle conflicts, amount of on-street parking, available unused pavement width, bus station conflicts, and related factors.

Alternative Evaluation

After assessing the feasibility of each alternative, the following categories were developed to enable decision makers and stakeholders to compare the feasible alternatives against each other. These categories are:

- Estimated Cost of Construction
- Maintenance Factors
- Capacity Implications
- Number of Parking Spaces Removed
- Quality of Connections
- Level of Traffic Stress
- Safety Considerations

The summary comparison matrix is provided as **Attachment A**.

Estimated Cost of Construction

The cost of construction was estimated for each alternative including signage and striping, existing striping removal, slurry seal of asphalt pavement, modification of traffic signals, and minor curb adjustments. Design and construction services were estimated at 20% of the construction cost.

Maintenance Factors

Each alternative was evaluated to compare the amount of additional maintenance, if any, required by the new facility. Maintenance includes the regular sweeping of the facility, as well as the repair and

replacement of weathered striping and signage. As the facility will be owned and maintained by the City of Reno, consideration was given to the use of existing City-owned sweeping equipment.

Capacity Implications

Where lane removals were determined necessary or more feasible than removing on-street parking, the implications on vehicle traffic capacity were quantified. Using the methodology described under “Parking and Traffic Operations,” the estimated 2040 peak hour volume per lane was determined for each of the alternatives. These volumes are summarized in **Attachment E**.

During frequent special event closures on Virginia Street, traffic is detoured onto Center and Sierra Streets, resulting in increased traffic volumes. To determine the theoretical maximum volumes on these streets during special events, traffic volumes were collected during Hot August Nights 2018. The same growth rates applied to the average daily traffic volumes were applied to the elevated special event volumes to determine projected 2040 special event traffic volumes on Center and Sierra Streets. These volumes are summarized in **Attachment E**.

Number of Parking Spaces Removed

Where removing on-street parking was deemed feasible, the number of removed parking spaces was quantified.

Quality of Connections

Each alternative was evaluated to determine how well the facility met the goal of providing a high-quality bicycle connection between the University of Nevada to downtown and midtown Reno. Considerations included to what extent the facility reached into midtown, the directness of the route, the ease of route-planning, if detours were needed to complete the connection, and access to major attractors.

Level of Traffic Stress

Level of traffic stress (LTS) is a term used to describe how much stress is imposed on a cyclist due to the surrounding traffic environment. The parameters were obtained from the Mineta Transportation Institute’s report *Low-Stress Bicycling and Network Connectivity*. Level of Traffic Stress was evaluated for both the road segments and intersections, as each present unique stresses to the rider. LTS is rated on a scale of 1 to 4, as described in **Table 1**.

Table 1: Levels of Traffic Stress for Bicycle Facilities

LTS 1	<i>Strong separation from all except low speed, low volume traffic. Suitable for riders of all ages and abilities, including children.</i>
LTS 2	<i>Cyclists have their own place to ride that is physically separated on high speed or multi-lane roadways. Crossings are not difficult but may be more complex than may be suitable for children.</i>
LTS 3	<i>An exclusive bike lane adjacent to multi-lane or moderate speed traffic or shared lane in low speed traffic. Bike lanes adjacent to narrow parking lanes. Comfortable to riders that would be classified as “enthused and confident”.</i>
LTS 4	<i>Any roadway with no exclusive bicycle riding zone and multiple lanes or high speeds. Comfortable to strong and fearless riders only.</i>

Level of traffic stress is closely correlated with the actual and perceived safety of the bicycle facility. In general, the fewer conflicts between vehicle and bicycle facilities, the less the risk of a vehicle-bicycle collision occurring and the lower the LTS. LTS is also representative of perceived safety which has a large role in determining how many riders will choose to use a facility. Figure 2 shows the four different types of cyclists by proportion of population, as developed by the City of Portland Office of Transportation.

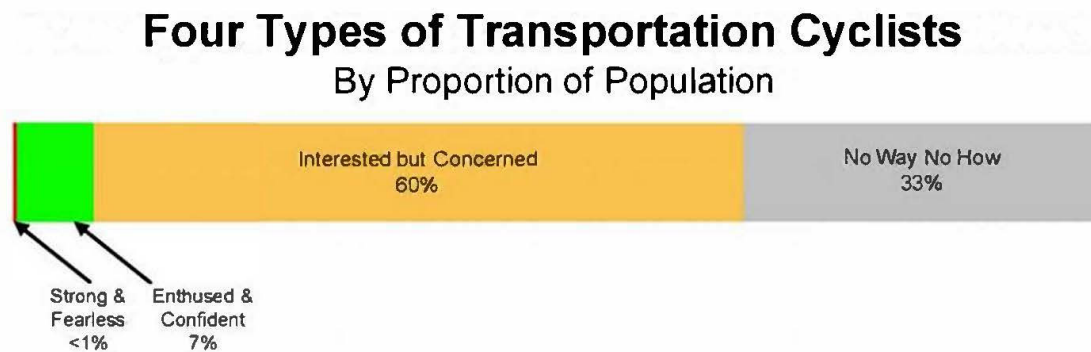


Figure 2: Four Types of Transportation Cyclists

A roadway with a level of traffic stress of 4 is likely only comfortable to riders considered “strong and fearless” - less than 1% of the population. Improvement to an LTS of 3 would provide comfort for enthused and confident riders as well as the strong and fearless, for a total of 8% of the population. As shown in Figure 2, the majority of the population is in the “interested but concerned” category, those that would like to use bicycles as transport but are concerned for their safety. Facilities with a low level of traffic stress, such as LTS 1 or 2, are much more likely to attract users in the “interested but concerned” category.

Safety Considerations

The alternatives were evaluated for overall safety to determine potential hazards associated with each of the proposed facilities. Considerations were given to the frequency of vehicle and bicycle conflicts as well as conflicts between bicycles and pedestrians.

EVALUATION OF ALTERNATIVES

Each alternative was evaluated for overall feasibility using the methods described above. The following sections provide a detailed analysis of each alternative.

Alternative 1: Two-Way Cycle Track on Center Street

A two-way cycle track is a dedicated bicycle facility that is separated from vehicle traffic with a physical barrier. A two-way cycle track would allow for cyclists to travel both north and south on Center Street. An example cross-section of this alternative is shown in **Attachment C-1**.

A two-way cycle track on Center Street would best be implemented on the west/left side of the road. This configuration is preferred over the east/right side for the following reasons:

- Conflicts with bus stations are eliminated.
- Northbound bicycle traffic is adjacent to northbound vehicle traffic.
- There are minimal curb line changes and obstructions.
- The bulk of attractors are to the west of Center Street. Placing the track on the left side would reduce the need for cyclists to cross Center Street.
- The left side provides areas of pavement within right-of-way that are not used for either parking or vehicle traffic.

Overall Feasibility

The National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide recommends a width for a two-way cycle track of 12 feet plus a 3 foot buffer. An absolute minimum of 8 feet with 3 foot buffer may be used in constrained environments. To accommodate this width within the existing curb lines, the removal of either on-street parking or one travel lane is required in most areas. Using the methodology described above, the most feasible removals of parking or a travel lane were determined. These areas are shown in **Attachment D-1**. In addition to the removal of parking and a travel lane, the ten traffic signals along the corridor will require modifications to provide signal indications to southbound cyclists.

It should be noted that from S. Virginia Street to Cheney Street, it would not be feasible to implement the cycle track due to the highly utilized on-street parking and single existing travel lane. Because of this, the best option would be to begin the cycle track at Cheney Street. Cheney Street provides connections to existing bicycle facilities on Holcomb Street to the east and to destinations on Virginia Street to the west.

Overall, with the removal of parking and a travel lane in specific segments, and modification of traffic signals, a two-way cycle track is a feasible alternative.

Pros & Cons of Alternative 1

Alternative 1 has a several unique benefits. The two-way cycle track is the only feasible alternative that allows for two-way bicycle traffic on one roadway. This results in simpler bicycle route planning as well as more efficient and cost effective construction. Additionally, with a physical barrier between the track and the vehicle travel way, this is the safest and most comfortable alternative for users of most ages and abilities.

However, of all of the alternatives, the two-way cycle track requires the largest reduction in on-street parking, nine more spaces than Alternative 3. This alternative also requires traffic signal modifications at each signal along the corridor, 10 signals in total.

Estimated Cost of Construction

The work needed to successfully implement the cycle track includes the removal of existing striping, the application of a slurry seal (layer of asphalt coating to preserve roadway surface), the installation of new pavement markings and delineators, and some spot curb, gutter, and sidewalk improvements. This estimate includes the installation of green painted lanes with a paint and delineator buffer. The two-way cycle track will also require modifications at the 10 traffic signals along the corridor. At this time, the condition of the existing traffic signals is unknown, therefore the estimate reflects costs for both moderate and major signal modifications. The breakdown of estimated costs is shown in **Table 2**.

Table 2: Two-way Cycle Track Cost Estimate

	Estimated Cost
Pavement Marking Removal	\$200,000
Slurry Seal	\$500,000
Signage and Striping	\$500,000
Curb, Gutter, and Sidewalk	\$120,000
Traffic Signal Modifications	\$1,000,000 - \$2,500,000
Design & Construction Services @ 20%	\$465,000 - \$765,000
Total	\$2.8 M - \$4.6 M

Maintenance Factors

Separated bicycle facilities require additional maintenance, particularly sweeping, as the typical “sweeping effect” of vehicles creating wind turbulents does not reach separated facilities. In order for the City to use its standard street-sweeping vehicles, the facility must be at least 11 feet wide. This can be achieved with the proposed two-way cycle track.

Additionally, if green paint and delineator treatments are used, these will require additional maintenance as weathering occurs and delineators are broken. Consideration should be given to utilizing green paint or green stamps, similar to the RTC Green Bike Stamp Project, in select locations.

Capacity Implications

Where the removal of travel lanes is preferred to removing parking, total roadway capacity will decrease. However, all of the segments where travel lane removal is proposed are projected to have sufficient capacity to serve 2040 peak hour volumes. The segments where a lane would be removed are shown in yellow on **Attachment D-1**, and summarized in **Table 3**.

Table 3: Two-way Cycle Track Capacity Implications

Center Street Segment	Existing Lane Configuration		Proposed Lane Configuration w/ Two-way Cycle Track	
	No. of Lanes	2040 Peak Hour Vehicles per Lane	No. of Lanes	2040 Peak Hour Vehicles per Lane
Cheney St to Liberty St	2	226	1	452
1 st St to 5 th St	3	423	2	634
Maple St to 8 th St	4	321	3	429
8 th St to 9 th St	3	220	2	331

It should be noted that the removal of a travel lane is proposed from 1st Street to 5th Streets in order to preserve the loading zones located adjacent to casinos and entertainment venues.

Additional traffic volumes on Center Street were collected during a Virginia Street event closure to obtain theoretical maximum volumes during special events, shown in **Table 4**.

Table 4: Special Event Traffic Volumes for Center Street

	Center Street	
	2 Lane	3 Lane
2018 Daily Traffic (Collected)	11700	11700
2040 Daily Traffic	16012	16012
2040 Daily Traffic Per Lane	8006	5337
2040 Peak Hour Traffic Per Lane	801	534

On Center Street, approximately 11,700 vehicles per day were recorded. Applying the growth rates indicated by RTC's Travel Demand Model and assuming peak hour traffic is 10% of daily traffic, the estimated number of peak hour vehicles per lane is 801 in segments with two lanes and 534 in segments with three lanes. These projected volumes indicate that the proposed configurations will provide acceptable traffic capacity during special events to the year 2040. A summary of estimated traffic volumes is provided in **Attachment E**.

Number of Parking Spaces Removed

In some segments of Center Street, it is more feasible to remove on-street parking than reduce the number of travel lanes. These areas, shown in red on **Attachment D-1**, were chosen because the parking is either under-utilized and/or nearby alternative parking is present. A total of 53 spaces would be removed under the proposed configuration. Thirty-four of these spaces are between 5th and 9th Street adjacent to primarily unoccupied buildings and blocks that are planned to be redeveloped. The other 19 spaces are metered parking spaces between Liberty and Mill Streets.

Quality of Connections

The two-way cycle track on Center Street would extend from Cheney Street in the south to 9th Street in the north, providing full two-way connectivity from UNR into the heart of Midtown. Providing a two-way facility simplifies route-planning, as north and southbound traffic can arrive and return along the same route. The physical separation of the bike and vehicle facilities also provides a connection that is comfortable for riders with a wide range of abilities. This alternative presents the best connection between UNR and Midtown.

Level of Traffic Stress

For both road sections and intersections, the existing level of traffic stress on Center Street is **LTS 4**, as it is a multi-lane road with no existing dedicated bicycle facilities. An example of the existing conditions is shown in **Attachment B**.

Since protected cycle tracks are the safest on-road facility type, the LTS would improve to LTS 1 in roadway segments and LTS 2 at intersections. The level of traffic stress is higher at intersections, as the more chaotic downtown environment may be difficult for some users, such as children, to navigate.

Considering the improved LTS, the implementation of a two-way cycle track on Center Street would change the street environment from serving strong and fearless riders only to a route that is comfortable for most riders.

Safety Considerations

Overall, protected cycle tracks are the safest on-road facilities available. Compared to traditional bike lanes, cycle tracks significantly reduce the frequency of vehicles crossing over bicycle facilities. However, some conflict points still exist at intersections and driveways, where turning vehicles must yield to cyclists within the track. On a one-way street such as Center Street, drivers may not be expecting two-way bicycle traffic. Implementation of this alternative should provide sufficient signage and pavement markings to promote awareness of contraflow bicyclists on the cycle track.

Alternative 2: Bike Lane Northbound on Center Street & Southbound on Sierra Street

Bicycle lanes are the most common dedicated bicycle facilities in the Truckee Meadows. While a bike lane may also be physically separated with a buffer, it is different from a cycle track by being located between the vehicle travel lane and parking lane, where parking exists. An example cross-section of this alternative is shown in **Attachment C-2**.

- On one-way roads like Sierra and Center Streets, a bike lane may be placed on the left or right side of the street. For Sierra and Center Streets, the study team determined the right side to be the better location because:
- Both the left and right sides of Sierra and Center Streets have similar numbers of turn conflicts.
- Bike lanes do not block bus stations like protected cycle tracks.
- Vehicles can typically expect bicyclists on the right hand side of the road.
- Transitions from the right to the left side are impractical, and bicycle lanes already exist on the right side of the roadway upstream of the study segments. For example, existing southbound

bike lanes on Sierra Street would have to transition to the left side via a dedicated bicycle signal phase or by directing cyclists to use the crosswalks. This can be avoided by simply continuing the track on the right hand side.

Overall Feasibility

The commonly desirable bike lane width is 6 feet. This width could be achieved by narrowing travel lanes on both Center and Sierra Street, making the bike lanes an overall feasible alternative.

It should be noted that a right side bike lane on Center Street should not be continued north of 7th Street due to the high volume of right turn conflicts at the freeway on-ramp. The bike lane should instead turn right to 7th Street to connect to existing bicycle facilities on Evans Ave, as shown on **Attachment D-2**.

Pros & Cons of Alternative 2

Alternative 2 is the only alternative that does not require the removal of parking or reduction in vehicle travel lanes. It is also the easiest to maintain, since the bike lane would be swept in the same manner as the rest of the roadway. This alternative also allows existing southbound bicycle facilities on Sierra Street to be continued through downtown all the way to California Street.

The bike lanes, however, do not significantly reduce the level of traffic stress, due to the numerous left and right turn conflicts and high-turnover on-street parking. This facility would be useful to more riders than just the strong and fearless, but still would not be comfortable for more timid or inexperienced bicyclists. Because the lanes would be implemented on two roadways, disturbance during construction would be greater than Alternative 1.

Estimated Cost of Construction

The work needed to successfully implement Alternative 2 includes the removal of existing striping, the application of a slurry seal, and the installation of new signs and pavement markings. The breakdown of estimated costs is shown in **Table 5**.

Table 5: Bike Lane Cost Estimate

	Center Street	Sierra Street
Pavement Marking Removal	\$200,000	\$150,000
Slurry Seal	\$500,000	\$825,000
Signage and Striping	\$200,000	\$150,000
Design & Construction Services @ 20%	\$180,000	\$225,000
Subtotal	\$1.1 M	\$1.4 M
Total	\$2.5 M	

Maintenance Factors

There is some additional maintenance involved with bike lanes, as debris swept from the road by vehicle traffic can accumulate in the lane. However, with no delineators, the bike lanes can be maintained in the same manner as the rest of roadway, making it easy to incorporate into the existing roadway sweeping schedule.

Additionally, if green paint treatments are used, these will require additional maintenance as weathering occurs and delineators are broken. Consideration should be given to utilizing green paint or green stamps in select locations.

Capacity Implications

To incorporate the bicycle lanes, some vehicle lane widths require narrowing to a width of 10 feet. Narrower lanes are likely to slow vehicle traffic which may have minor implications on capacity. However, as existing capacity is sufficient to serve projected 2040 volumes, this is not a significant issue.

Number of Parking Spaces Removed

The bike lane alternative does not require the removal of any parking on Sierra Street or Center Street.

Quality of Connections

Providing bicycle lanes on Sierra Street adds a direct southbound extension from the existing facilities north of the freeway. The northbound bike lane on Center Street would add a dedicated facility for riders from central Midtown to the University of Nevada. As riders must use different routes to travel north and south, route-planning may not be as straightforward as a single road with two-way facilities. The southbound route would end at California Street at the northern edge of Midtown, so this alternative would not provide as good of a Midtown connection as Alternative 1.

Level of Traffic Stress

The existing level of traffic stress on both Sierra Street and Center Street is LTS 4. Both streets in the study segment are multi-lane roads with no existing dedicated bicycle facilities. Implementing bike lanes on both roadways would improve the overall level of traffic stress to LTS 3. Even with bike lanes, the level of traffic stress would be quite high. This is because of the presence of frequent turn lanes and high-turnover on-street parking which require traffic to cross over the bike lane. A greater number of adjacent travel lanes also adds to the level of stress, as traffic is more turbulent and drivers are less likely to see a bicyclist in the far right lane.

Safety Considerations

Although a dedicated bicycle facility is safer than riding with mixed traffic, it does not compare well with the improved safety provided by a buffered cycle track. There are still hazards present for cyclists, as vehicles must frequently cross the bike lane to enter right turn lanes and on-street parking bays. The lack of a buffer between parking and the bike lane puts cyclists at greater risk of being “doored” by drivers exiting parked vehicles.

Alternative 3: One-way Cycle Track Northbound on Center Street & Southbound on Sierra Street

A one-way cycle track is a dedicated bicycle facility that is separated from vehicle traffic with a physical barrier. An example cross-section of this alternative is shown on **Attachment C-3**. A southbound cycle track would be implemented on Sierra Street with a northbound cycle track on Center Street.

One-way cycle tracks would be best implemented on the right side of Sierra Street for many of the same reasons listed under Alternative 2. Some special treatments would need to be applied for bus stops on

Sierra Street. On Center Street, the cycle track would best be implemented on the left side of the street, for the same advantages listed under Alternative 1.

Overall Feasibility

The National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide recommends widths of 5 to 7 feet for a one-way cycle track plus a 3 foot buffer. For this analysis, a minimum width of 6 feet wide with a 3 foot buffer was used. To accommodate this width within the existing curb lines, the removal of either on-street parking or a travel lane is required in most areas of Center Street and some areas on Sierra Street. Using the study methodology, the most feasible removals of parking or a travel lane were determined. The modification areas are shown in **Attachment D-3**.

Pros & Cons of Alternative 3

Similar to the two-way cycle track (Alternative 1), one-way cycle tracks on Center and Sierra Streets would provide greatly improved safety and levels of traffic stress to attract cyclists having a wide range of abilities. Additionally, the cycle track would extend the existing bicycle route on Sierra Street through downtown all the way to California Street, connecting the overall bicycle network.

However, wrong-way riding could likely become an issue on one-way tracks, as some cyclists choose the most convenient protected path despite directional lanes. The narrower track widths prevent cyclists from passing comfortably, and would also require special sweeping equipment. Overall cost of construction would be higher because the lanes would be implemented on two roadways.

Estimated Cost of Construction

The work needed to successfully implement the one-way cycle tracks includes the removal of existing striping, the application of a slurry seal, the installation of new pavement markings and delineators, as well as some spot curb, gutter, and sidewalk improvements. The breakdown of estimated costs is shown in **Table 6**.

Table 6: One-Way Cycle Track Cost Estimate

	Center Street	Sierra Street
Pavement Marking Removal	\$200,000	\$150,000
Slurry Seal	\$500,000	\$825,000
Signage and Striping	\$410,000	\$350,000
Curb, Gutter, and Sidewalk	\$120,000	\$120,000
Design & Construction Services @ 20%	\$250,000	\$290,000
Subtotal	\$1.5 M	\$1.7 M
Total	\$3.2 M	

Maintenance Factors

Separated bicycle facilities require additional maintenance, particularly sweeping, as the typical sweeping effect of vehicles on the roadway does not occur. Since the proposed one-way cycle track would be narrower than 11 feet, standard street sweeping equipment could not be used for maintenance. Smaller, specialized sweeping vehicles would have to be purchased to maintain the track. Additionally, if green

paint and delineator treatments are used, these will require additional maintenance as weathering occurs and delineators are broken.

Capacity Implications

Where the removal of a travel lane is preferred to removing parking, total roadway capacity will decrease. However, all of the segments where travel lane removal is proposed are projected to have sufficient capacity to serve 2040 peak hour volumes. These segments are shown in yellow on **Attachment D-3**, and summarized in **Table 6**.

Table 6: One-way Cycle Track Capacity Implications

Center Street Segment	Existing Lane Configuration		Proposed Lane Configuration w/ Two-way Cycle Track	
	No. of Lanes	2040 Peak Hour Vehicles per Lane	No. of Lanes	2040 Peak Hour Vehicles per Lane
Cheney St to Liberty St	2	226	1	452
1 st St to 5 th St	3	423	2	634
Maple St to 8 th St	4	321	3	429
8 th St to 9 th St	3	220	2	331
Sierra Street Segment	No. of Lanes	2040 Peak Hour Vehicles per Lane	No. of Lanes	2040 Peak Hour Vehicles per Lane
Commercial Row to 1 st St	3	382	2	572

Additional traffic volumes on Sierra Street were collected during a Virginia Street event closure to obtain theoretical maximum volumes during special events, shown in **Table 7**.

Table 7: Special Event Traffic Volumes for Center Sierra Streets

	Center Street		Sierra Street	
	2 Lane	3 Lane	2 Lane	3 Lane
2018 Daily Traffic (Collected)	11700	11700	21500	21500
2040 Daily Traffic	16012	16012	25812	25812
2040 Daily Traffic Per Lane	8006	5337	12906	8604
2040 Peak Hour Traffic Per Lane	801	534	1291	860

On Center Street, approximately 11,700 vehicles per day were recorded. Applying the growth rates indicated by RTC's Travel Demand Model and assuming peak hour traffic is 10% of daily traffic, the estimated number of peak hour vehicles per lane is 801 in segments with two lanes and 534 in segments with three lanes. These projected volumes indicate that the proposed configurations will provide acceptable traffic capacity during special events to the year 2040.

On Sierra Street, approximately 21,500 vehicles per day were recorded. Applying the growth rates indicated by RTC's Travel Demand Model and assuming peak hour traffic is 10% of daily traffic, the estimated number of peak hour vehicles per lane is 1291 in segments with two lanes and 860 in segments with three lanes. These projected volumes indicate that with only two lanes in certain segments, traffic

volumes on Sierra Street will exceed capacity during special events. A complete summary of estimated traffic volumes is provided in **Attachment E**.

Number of Parking Spaces Removed

In some segments of Center Street and Sierra Streets, it is more feasible to remove on-street parking than reduce the number of travel lanes. These areas, shown in red on **Attachment D-3**, were chosen because the parking is either under-utilized and/or nearby alternative parking is present. A total of 44 spaces would be removed under Alternative 3. Twenty one of these spaces are between 5th and 9th Street adjacent to primarily unoccupied buildings in redevelopment areas. Nineteen spaces are metered parking spaces between Liberty and Mill Streets, and four are metered spaces on the Sierra Street bridge crossing the Truckee River.

Quality of Connections

The southbound one-way cycle track would extend the existing bicycle route on Sierra Street through downtown all the way to California Street, connecting the overall bicycle network. The northbound cycle track on Center Street would add a dedicated facility for riders from central Midtown to the University of Nevada, Reno. As riders must use different routes to travel north and south, route-planning may not be as straightforward as on one road with two-way facilities. The southbound route would end at California Street at the northern edge of midtown, so this alternative would not provide as good of a midtown connection as Alternative 1.

Level of Traffic Stress

The existing level of traffic stress on Center Street is LTS 4, as it is a multi-lane road with no existing dedicated bicycle facilities.

Protected cycle tracks are the safest on-road facility type, and the LTS would improve to LTS 1 in roadway segments and LTS 2 at intersections. The level of traffic stress is higher at intersections because of the more chaotic downtown environment may be difficult for some less experienced cyclists to navigate. Overall, implementation of a two-way cycle track on Center Street would change the street environment from serving strong and fearless riders only to a route that is comfortable for most riders.

Safety Considerations

Overall, separated bicycle lanes are the safest on-road facilities available. However, conflict points would still exist at intersections and driveways, where vehicles must yield to cyclists on the track.

Wrong-way riding may be an issue as some cyclists will choose the most convenient protected path despite directional lanes. Wrong way riding can be dangerous for cyclists, especially where the track is too narrow for cyclists to safely pass.

Alternative 4: Two-way Cycle Track on Virginia Street

The fourth alternative, a center-running two-way cycle track on Virginia Street from 9th Street to Mary/Center Streets, was the only alternative found to not be feasible. A center running cycle track would require left turns to be restricted along Virginia Street, which would cause unacceptable traffic operations throughout the corridor. Also, Virginia Street in the entertainment district of downtown is regularly closed

for special events, which would frequently limit access to the bicycle facility. This alternative is also inconsistent with the Virginia Street BRT Extension project which does not include bicycle facilities on Virginia Street. Bicycles traveling this route would need to detour south of Liberty Street, providing poor quality of connection. For these reasons, Alternative 4 is not considered feasible, and no further study was performed.

PUBLIC ENGAGEMENT

Meetings & Presentations

The results of this analysis were presented by RTC staff at the following meetings, where feedback was gathered from both decision makers and interested citizens:

August 1, 2018	RTC Technical Advisory Committee (TAC) August Meeting
August 1, 2018	RTC Citizen's Multimodal Advisory Committee (CMAC) August Meeting
August 17, 2018	RTC Board August Meeting
August 20, 2018	Center, Sierra, and Virginia Streets Bicycle Facilities Analysis Public Meeting
August 22, 2018	Reno City Council Meeting

The analysis was presented at the TAC and CMAC meetings, to solicit input. Participants were asked to give comments, but a vote regarding a preferred alternative was not conducted. CMAC provided input that was overwhelmingly in favor of Alternative 1. Attendees at the August 20th public meeting overwhelmingly voiced support for Alternative 1, the two-way cycle track on Center Street, as shown in **Figure 3**. Both the RTC Board and Reno City Council also selected Alternative 1 as the preferred alternative.

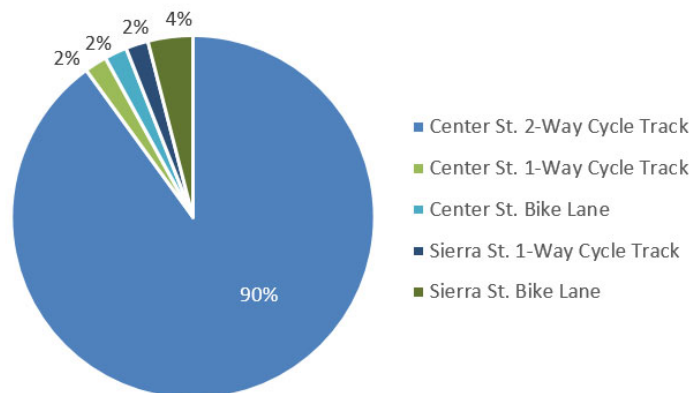


Figure 3. Public meeting attendee preferences.

In addition to public meetings, public comments, generally in support of Alternative 1, were also received by the RTC. These are provided in **Attachment F**.

Truckee Meadow Bike Alliance Survey

The Truckee Meadow Bike Alliance (TMBA) conducted a survey to assess which transportation modes University of Nevada, Reno students and staff use to get to downtown and midtown Reno and what would

encourage them to choose bicycling over other modes. Of the 763 respondents, 24% responded they would either ride for the first time, or ride more often, with a standard bike lane between UNR/Midtown. 81% responded they would either ride for the first time, or ride more often, with a protected cycle track between UNR/Midtown. TMBA has expressed a strong preference for Alternative 1 (two-way cycle track on Center Street).

CONCLUSIONS & RECOMMENDATIONS

The analysis of the four alternatives concluded that three alternatives could be feasibly implemented within the existing pavement width of Center and Sierra Streets. The three feasible alternatives are:

1. A two-way cycle track on Center Street from Cheney Street to 9th Street.
2. A northbound bike lane on Center Street from S. Virginia Street (at Mary Street) to 9th Street AND a southbound bike lane on Sierra Street from 9th Street to California Avenue.
3. A one-way cycle track northbound on Center Street from S. Virginia Street (at Mary Street) to 9th Street AND southbound on Sierra Street from 9th Street to California Avenue.

The fourth alternative, a center-running two-way cycle track on Virginia Street from 9th Street to Mary/Center Streets, was the only alternative found to not be feasible.

Overall, the two-way cycle track on Center Street offers the greatest safety and best connectivity improvement for the cost. The separation from vehicle traffic and directness of the route makes this facility the most attractive to bike riders of all abilities. It was also chosen as the preferred alternative by the RTC Board and Reno City Council. However, this alternative does require more removal of on-street parking than the other options, and requires signal modifications at 10 locations.

Similarly, one-way cycle tracks on Center and Sierra Streets would provide low levels of stress, comfortable for most users. The Sierra Street facility would also extend existing bicycle facilities on North Sierra Street through downtown all the way to California Ave, improving the overall bicycle network. Maintenance of these cycle tracks would require special street sweeping equipment, and wrong-way riding may also become an issue as riders choose the most convenient protected route. Implementation of the track on Sierra Street will reduce available capacity and is likely to cause unacceptable traffic operations during special event closures on Virginia Street.

The implementation of dedicated bicycle lanes would be the simplest to maintain, and would not require any parking or vehicle lane removal. However, this alternative offers the smallest improvement in level of traffic stress and is unlikely to attract users that are not already confident cyclists. Ridership could ultimately be low even after a considerable cost expenditure.

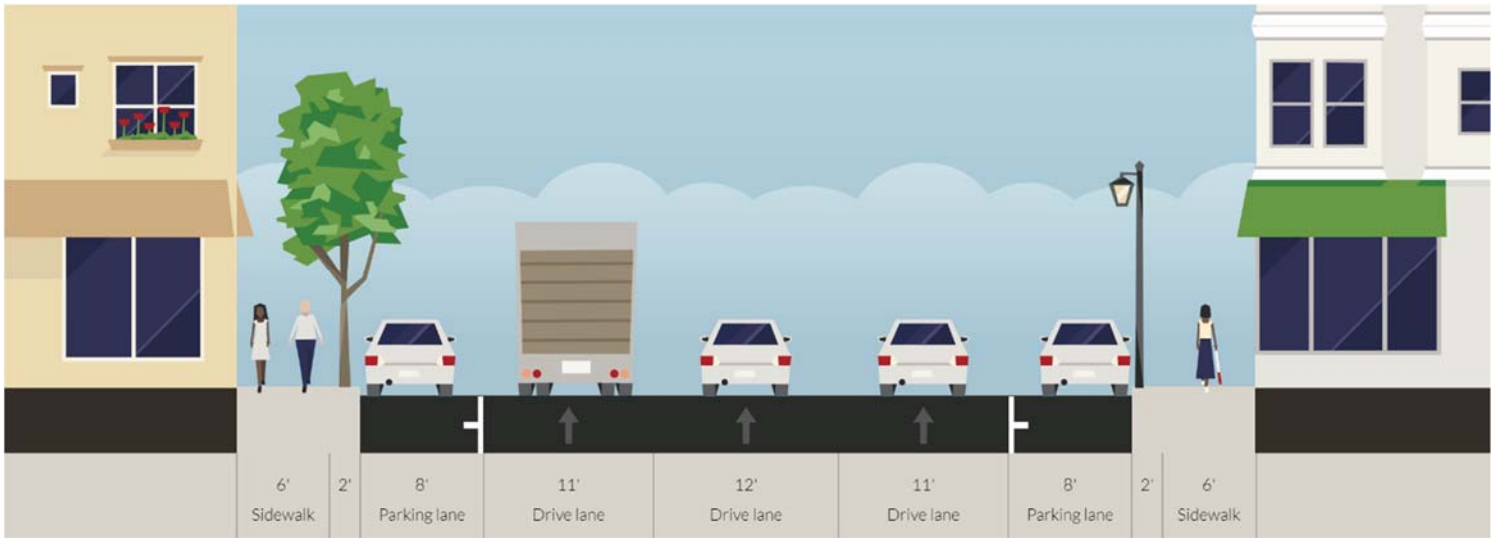
It is the consulting team's recommendation that the two-way cycle track (Alternative 1) will best meet the project goals of a high quality connection from UNR to midtown and will result in the greatest value (highest ridership per cost) to the community. Should providing bicycle facilities on Sierra Street remain a priority, the most feasible alternative would be Alternative 2, bike lanes.

ATTACHMENT A

Alternatives Comparison Matrix

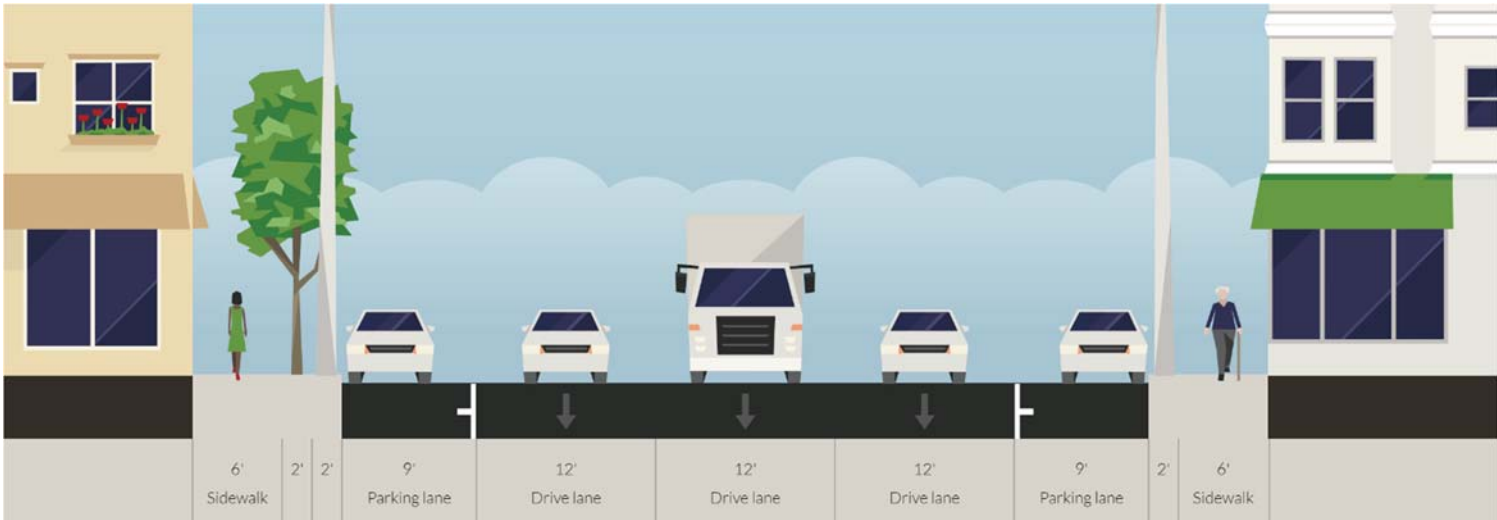
* Level of Traffic Stress (LTS) is a rating system for road segments indicating traffic stress imposed on bicyclists. LTS values range from 1 (Comfortable to bicyclists of all ages and abilities) to 4 (Strong and Fearless bicyclists only).

Existing Conditions



CENTER STREET

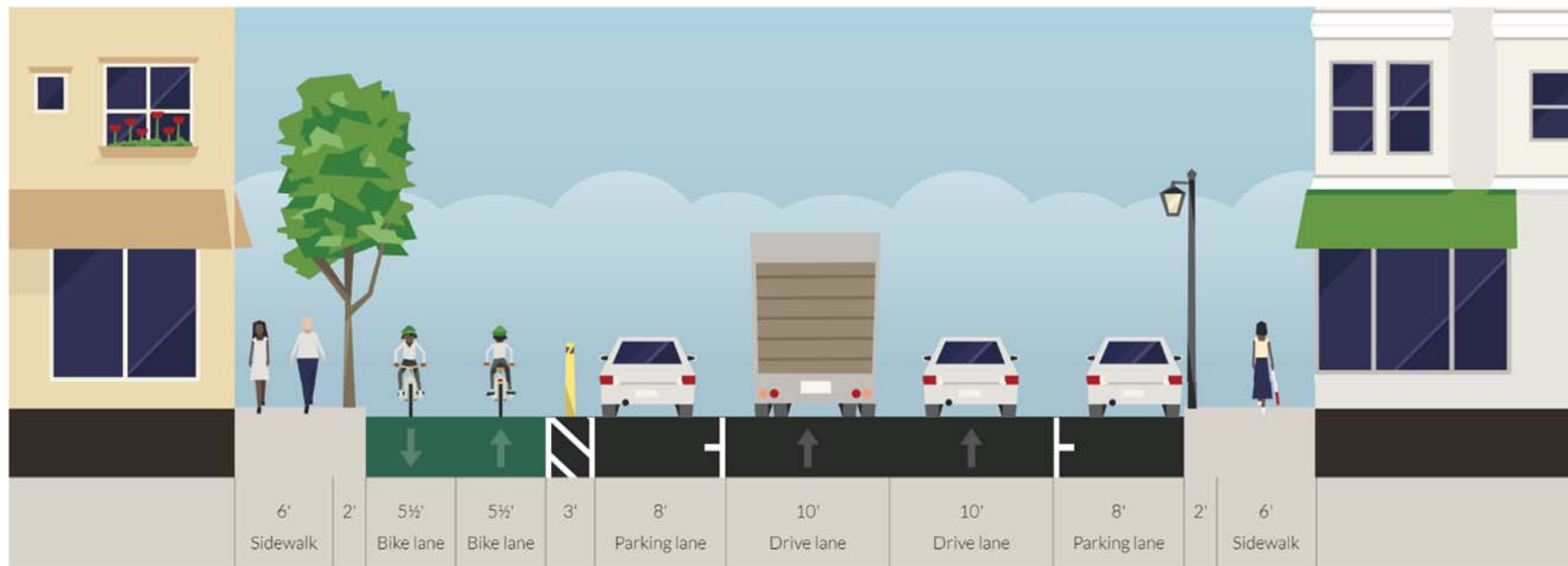
Typical Curb to Curb Width = 50'



SIERRA STREET

Typical Curb to Curb Width = 54'

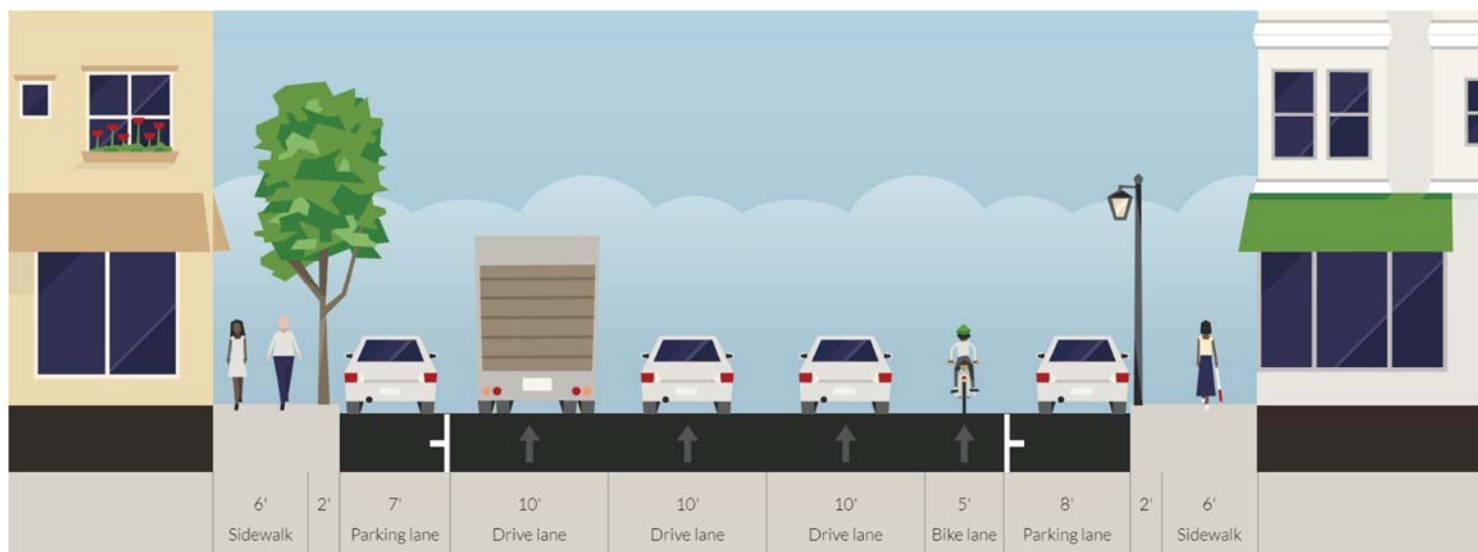
ALTERNATIVE 1: *Two-Way Cycle Track*



CENTER STREET

Typical Curb to Curb Width = 50'

Alternative 2: *Bicycle Lanes*



CENTER STREET

Typical Curb to Curb Width = 50'



SIERRA STREET

Typical Curb to Curb Width = 54'

Alternative 3: One-Way Cycle Tracks



CENTER STREET

Typical Curb to Curb Width = 50'



SIERRA STREET

Typical Curb to Curb Width = 54'

Legend

- Adjust Lane Widths
- Remove Travel Lane
- Remove Parking

Existing Facilities

- Existing Bike Lane
- Existing Bike/Multi-Use Path
- Planned Bike Lane

13 Parking Spaces

21 Parking Spaces

19 Parking Spaces

Begin Cycle Track

Alternative 1:

Two-Way Cycle Track
On Center Street



Adjust Lane Widths

Existing Facilities

Existing Bike Lane

Existing Bike/Multi-Use Path

Planned Bike Lane

Alternative 2:

**Bike Lanes
Northbound Center
Southbound Sierra**

Legend

Adjust Lane Widths

Remove Travel Lane

Remove Parking

Existing Facilities

Existing Bike Lane

Existing Bike/Multi-Use Path

Planned Bike Lane

21 Parking
Spaces

4 Parking
Spaces

19 Parking
Spaces

Alternative 3:

**One-Way Cycle
Track
Northbound Center
Southbound Sierra**

Projected 2040 Traffic Volumes

Center Street

ATTACHMENT E

	Center Segment 1 Mary / S. Virginia to Cheney				Center Segment 2 Cheney to Liberty				Center Segment 3 Liberty to Mill				Center Segment 4 Mill to 1st				Center Segment 5 1st to Plaza			
	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track
	2040 AADT	2040 AADT per Lane	2040 Peak Hour per Lane		2040 AADT	2040 AADT per Lane	2040 Peak Hour per Lane		2040 AADT	2040 AADT per Lane	2040 Peak Hour per Lane		2040 AADT	2040 AADT per Lane	2040 Peak Hour per Lane		2040 AADT	2040 AADT per Lane	2040 Peak Hour per Lane	
	4568	4568	4568	4568	4519	4519	4519	4519	8277	8277	8277	8277	10573	10573	10573	10573	12677	12677	12677	12677
	4568	4568	4568	4568	2260	2260	4519	4519	4139	4139	4139	4139	5287	5287	5287	5287	4226	4226	6339	6339
	457	457	457	457	226	226	452	452	414	414	414	414	529	529	529	529	423	423	634	634

	Center Segment 6 Plaza to 5th				Center Segment 7 5th to 7th				Center Segment 8 7th to Maple				Center Segment 9 Maple to 8th				Center Segment 10 8th to 9th			
	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	2W Cycle Track
	2040 AADT	12541	12541	12541	13600	13600	13600	13600	13897	13897	13897	13897	12858	12858	12858	12858	6612	6612	6612	6612
	2040 AADT per Lane	4180	4180	6271	6271	4533	4533	4533	4533	4632	4632	4632	4632	3215	3215	4286	4286	2204	3306	3306
2040 Peak Hour per Lane	418	418	627	627	453	453	453	453	463	463	463	463	321	321	429	429	220	331	331	331

During Virginia Street Closure*	
2 Lane	3 Lane
2018 Daily Traffic (Collected)	11700
2040 Daily Traffic	16012
2040 Daily Traffic Per Lane	8006
2040 Peak Hour Traffic Per Lane	801
	534

*Traffic volumes were collected on a Saturday during the Hot August Nights 2018 event closure of Virginia Street.

Projected 2040 Traffic Volumes

Sierra Street

ATTACHMENT E

		Sierra Segment 1 9th to 8th			Sierra Segment 2 8th to Maple			Sierra Segment 3 Maple to 6th			Sierra Segment 4 6th to 5th			Sierra Segment 5 5th to Comm Row		
		Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track
2040 AADT		12975	12975	12975	12396	12396	12396	13305	13305	13305	13291	13291	13291	12829	12829	12829
2040 AADT per Lane		3244	3244	3244	4132	4132	4132	4435	4435	4435	4430	4430	4430	4276	4276	4276
2040 Peak Hour per Lane		324	324	324	413	413	413	444	444	444	443	443	443	428	428	428

		Sierra Segment 6 Comm Row to 1st			Sierra Segment 7 1st to Island			Sierra Segment 8 Island to Liberty			Sierra Segment 9 Liberty to California		
		Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track	Existing Config.	Bike Lane	1W Cycle Track
2040 AADT		11447	11447	11447	8625	8625	8625	9350	9350	9350	9550	9550	9550
2040 AADT per Lane		3816	3816	5724	4313	4313	4313	4675	4675	4675	2388	2388	2388
2040 Peak Hour per Lane		382	382	572	431	431	431	468	468	468	239	239	239

		During Virginia Street Closure*	
		2 Lane	3 Lane
2018 Daily Traffic (Collected)		21500	21500
2040 Daily Traffic		25812	25812
2040 Daily Traffic Per Lane		12906	8604
2040 Peak Hour Traffic Per Lane		1291	860

*Traffic volumes were collected on a Saturday during the Hot August Nights 2018 event closure of Virginia Street.

Center/Sierra/Virginia Bike Facility Alternatives Public Comments

Comment

Hello, Just a quick note to say that I'm in support of constructing a two-way cycle track with physical separation from traffic along Center Street as a north-south corridor for bike commuters. I've lived in Reno for 17 years and I love it here and think that we should be promoting healthy transportation, including improving infrastructure to support alternative methods of transport such as cycling. I've also spent a lot of my time commuting by bike around Reno and it can be pretty dangerous. I think that for everyone, but especially people who are new to biking (like many Limebike riders, for example), having designated cycle tracks will really help with safety and decrease conflicts with vehicle traffic. I would also love to see the river path cleaned-up, as this is a major east-west corridor for bicycle commuting but often feels unsafe (pavement needs improvement and transients live all along the path/river) and it also smells bad. That's probably not in RTC's jurisdiction... Thank you for your consideration!

Hi there, I'm writing in support of the proposed 1-way or ideally 2-way bike lane on Center St. I'm an avid cyclist and I love the idea – we really need a cycling thoroughfare to connect the university area and downtown/Midtown. Especially now with Lime Bike, we have a ton more cycling traffic in the downtown core and we need infrastructure to support that as well as keep people safe. Thanks!

FYI, I was the Traffic Design Engineer for the City of Reno and was the lead engineer that worked to implement the City of Reno Road Impact Fee Program that ultimately became the Regional Road Impact Fee program. I am intimately familiar with our areas streets from a traffic, bicycle, and pedestrian standpoint.

I also sit on the capital improvements advisory committee for Washoe County and annually review and comment on the RRIFF capital improvement program.

I support additional bicycle facilities but not if they adversely affect pedestrian and vehicular traffic.

I believe many of our “Road dirt streets” have neglected vehicular and pedestrian traffic. I doubt anyone looked at side street traffic from either a vehicular or pedestrian function level. For example, adding roundabouts at key side streets could have turned many of these projects from a “D” to an “A”

Center Street lost significant traffic capacity when it was reduced to a single lane with parking on both sides. Once the Virginia Street project commences, this could become a significant issue.

However, one block east is the Holcomb/Sinclair/Evans north south link, a much under utilized roadway system. Has anyone looked at coupling this system along with the planned improvements on Virginia Street?

I'm concerned that the excitement to add bicycle capacity is getting in the way of sound engineering analysis. If this is pushed too far, RENO citizens will make their anger known and this could set back bicycle planning for many years. Many senior citizens travel these streets on a daily basis and have reduced reaction times pulling out from side streets. Has this been considered?

I will fully support additional bicycle capacity but only if all stakeholders are involved and full consensus is achieved with all. Thanks,

To Whom It May Concern:

I am writing today to strongly support the implementation of better bicycle infrastructure on Center, Sierra, and Virginia Street. I support the proposed cycle cross tracks on all of the aforementioned streets and hope that there is potential to implement them across the board, or at the very least provide bicycle lanes if all three cycle cross projects are not feasible. All of these streets are main thoroughfares of our downtown area and are entirely unsafe for cyclists presently. As a long-time Reno resident, full-time UNR student, and daily-cycling commuter, I depend on all of these streets to navigate the city. With little to no shoulders, high-speed and congested traffic and parking zones, and general misconceptions of the rules of the road pertaining to cycling, these streets can prove to be very dangerous, even for the most advanced riders. The implementation of better bicycle infrastructure will encourage healthier life styles, reduce our carbon foot print, lower the rate of automobile fatalities, increase revenue for local businesses, and provide access to our great city with a whole new lens. We've already begun swinging the pendulum of progress in the right direction with the implementation of a bike share program, but it is pointless to put citizens on bicycles (many of whom have no prior biking experience) and not support them with a well-planned and safe cycling infrastructure. We owe it to Reno residents to take the knowledge we have of the many benefits of multi-modal access and build a city that reflects progressive infrastructure for many generations to come. Thank you for your consideration and keep up the good work!

I really think the two way cycle track is the best option. People prefer being around other people and given the opportunity, engaging cyclists in the same area is a much better design alternative than a single track by itself on sierra. Thanks!

Hello,

I am unable to make the meeting about Safe Cycling Infrastructure tonight because I have already committed to the PTA meeting for my son, however this topic is top priority for me since I live in Midtown and ride my bike to UNR 5 days per week, as I work in the Geothermal Department at the Nevada Bureau of Mines. Please make this bike commute safer. It really is scary.

I support safe biking, eco transport, in Reno. I am happy to have my tax \$\$\$\$\$ spent on things like this. Thank you.

Greetings, I'm a Reno cyclist and really like the idea of a safe bike corridor between UNR and Downtown. Please make it happen! Thank you!

The two way cycle track would be a game-changer. On behalf of Limebike, we are in full support of alternative 1. Thank you!! I'd also like to suggest that Forrest Street is also moved up on the schedule the same year as well as a two-way cycle track on Sierra Street going south.

I would like to add a note of support to a 4th alternative. A two way cycle track on sierra and center.

I heard that loading zones are a concern for safety, perhaps there could be loading/parking zones and times that are not during peak traffic? Also, (not related) all lanes are bike lanes and I think there could be more awareness through social media and the news about morning over a lane when possible (i.e. Lakeside Drive). It could help make more roads bicycling friendly w/out investing too much in infrastructure now. Thank you for all you are doing and done to make Reno a city for people to live in and walk and bike and be safe!

I work at UNR and commute by bike almost daily. I support Alternative 1 because a 2 way protected cycle track is the most ambitious option, but will have the most impressive results. There are so few direct bike routes to UNR from Midtown, and I think this is an obvious reason students rarely head south from campus.

2-way cycle tracks make people feel safe enough to ride who might not otherwise. Good for everyone – businesses, individuals to having an awesome city. 2-way both on sierra and center would be even better! (just on center).

Please make Reno more bike friendly. If you build it they will come. Thank you having the meeting and reaching out. Alternative 1 on both Center Street and Sierra Street is definitely the winning option – thanks!

Any and all improvements are greatly appreciated – it seems like the liveliness and committee feel – vibrancy would be enhanced with the two-way tracks – cyclists love acknowledging each other – which adds to a community/neighborhood/feel – Thanks for all cycling improvements!

Love the 2-way separated tracks! Please put a 2-way separated bike lane on Center and Sierra Streets. Thanks!

Strongly in favor of Opt. 1, 2-way cycletrack on Center between UNR and Virginia. This infrastructure is amazing but not the first of its kind by any means. Many similar sized and demographic cities have installed them with great safety, connectivity, and economic benefits. Lean on existing lessons learned for efficiency. This can be done here! Aim high RTC! Thank you!

Thank you so much for building these plans and opening for public comment! I like the two-way cycle protected bike lane. I like the suggestions of a two-way on both Sierra and Center! What really stood out, "people will go both ways on the track no matter if it is one way or not" I think this is very true! More bike access would be even better and awesome!

Alternative 1, should be 2 way cycle track on both Sierra and Center Streets.

Reno Collective and I personally am in support of Alternative 1 for cycling facility. Most of our members live along the corridor and would benefit from these new transportation options.

As a business owner on Center Street I endorse the 2 lane cycle track on Center. Employing 7 people and 50% of them cycle to work multiple times a week, I'd like to promote a safer ride to work for them, our community and my family. I's also like to see an option with following: Traffic, Traffic, Parking, Bike Lane. This would make it even safer and prevent dooring.

Support: Better connectivity, Improved health/well being, Less car traffic, Economic benefits for businesses. Thanks!

Could it be considered to implement a solar element to bike path like "STARRY NIGHT" in the Netherlands. I'm a downtown business owner and community activist. I've facilitated bike events and the feedback has always been safety concern. One of the biggest lessons we've learned when implementing change is all or nothing. Strongly in support.

Although and appreciate the need and design of the cycle tracks, given the current state of road sweeping currently. Among all 4 jurisdictions. Particularly Sparks and older sparks, but Washoe County is not much better. I have zero confidence of the maintenance of a cycle track, even with its own dedicated sweeper, if the existing equipment isn't scheduled to be used on a reasonable schedule, much less after any off "schedule" for service. What makes the cycle track problematic is any debris is more likely to be found there and become a greater hazard than it might ordinarily be in an open lane. Though I have no issue with the concept, given my experience as a regular commuter, at this time and reluctantly have to "recommend" the bike lane to the left of on street parking, primarily due to the inadequate to nonexistent road maintenance levels currently for roadsides. I have a concern with the existing road maintenance levels on bike lanes in the City of Reno as it is new. Riding here to City Hall tonight, I encountered several areas for broken glass in existing bike lanes as they are now and that's with the City of Reno's "Scheduled", no exceptions, for road sweeping as it is now.