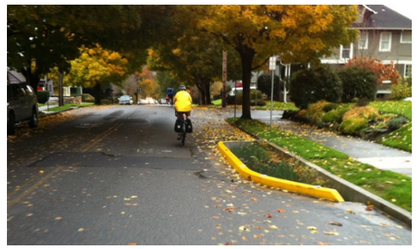
Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
ON-STREET PARKING OPTIONS				
Variable On-Street Parking				
Variable On-Street Parking is the act of alternating which side of the road parking is allowed along the length of the street.		– Requires moving vehicles to alternate sides of the roadway based on which side vehicles are parked on.	– Signing would be required to ensure compliance and avoid confusion.	
HORIZONTAL STREET MODIFICATIONS				
Bump-Outs/Curb-Extensions				
Bump-outs are constructed as a curb extension to reduce the width of the travelway. These devices are often used to facilitate parking downstream. If installed at intersections, they reduce the speeds of turning vehicles and effectively reduce the street width, which significantly improves pedestrian crossing distance and times as well.		– FHWA data indicates an average reduction in operating speeds on 1-4 mph. – Provides protection for parking which increases safety for pedestrians as well as vehicles when entering and exiting the parking area.	– Narrows travelway for bicyclists and creates some loss of parking. – Presents a fixed object within the travelway that may be struck by vehicles especially snow plows etc.	An estimated cost per set of bump-outs of $5,000-$20,000 (including landscaping) is suggested, depending on site conditions and the extent of landscaping.
Chicanes				
Chicanes are adjacent to the curb on alternating sides of the street in sets of three to introduce an S-shape travel path on a straight section of street that compels vehicles to slow down to negotiate the curved section.		– FHWA indicates an average reduction in operating speeds of 3 to 9 mph. – Provides for adding greenery and thus enhance the attractiveness of the street.	– Narrows travelway for bicyclists and creates some loss of parking. – Presents a fixed object within the travelway that may be struck by vehicles especially snow plows etc. – With no physical separation between the travel directions drivers tend to cross the centerline to make their travel path as smooth as possible through the chicane, particularly an issue when there is a vehicle approaching in the opposing lane who may be doing the same. This cross-centerline behavior is a potential safety concern and contributes to a general ineffectiveness of the device in terms of speed reduction.	An estimated cost for asphalt chicanes of $10,000 (for a set of three chicanes) is suggested and $16,000 for a concrete set of three. Drainage may be the most significant cost consideration.
Mini-Circles				

Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
Mini-circles are raised circular islands constructed in the center of residential street intersections. They reduce vehicle speeds by forcing motorists to maneuver around them and are sometimes used instead of stop signs.		– Shown to reduce crashes – Reduces vehicles speeds at the intersection	– Larger vehicles that need access to streets may need to make left hand turns in front of the circle.	The cost for a landscaped traffic circle on an asphalt street is about $6,000 and ranges from $8,000 to $12,000 for a landscaped mini-circle on a concrete street.
Forced Turn Islands (Right-in/Right-out)				
Forced turn islands involve the construction of raised islands at intersection approaches to prohibit certain turning movements. When used in combination with turn restriction signage, median closures, and partial closures, forced turn islands provide additional means to direct through traffic to the collector roadway network and off neighborhood streets.		– Reduces cut through traffic – Reduces speeds and volume in immediate area – May improve intersection safety by eliminating vehicular conflict points	– Delays emergency vehicles – Traffic diverted to adjacent streets may create new traffic problems – Increased travel time and out of direction travel for local residents – May increase u-turning movements and encourage wrong way travel	The approximate cost of a forced turn island is $1000-$15,000, depending on size, materials, and drainage.
VERTICAL STREET MODIFICATIONS				
Speed Humps				
A Speed Hump is a vertical device with a raised parabolic shaped area in the roadway, extending across the road at right angles to the traffic. The raised surface is higher, and occurs over a shorter travel distance than for other vertical devices. Speed humps are the most commonly used traffic calming devices.		FHWA & ITE indicates an average reduction in operating speeds of 5-8 mph. – Speed Humps are among the most recognizable traffic calming devices, which may promote a quicker response by motorists to reduce their speed.	– Increases noise to nearby residents as vehicles pass over the device (particularly larger trucks) – Impedes bicyclists – Impacts travel times of emergency vehicles and transit (buses)	The estimated cost for a speed hump is $2,000 depending on drainage conditions and materials used.
Speed Lumps				
A Speed Lump is a modified Speed Hump where openings are added to accommodate emergency or other large vehicles to utilize the openings without traversing over the raised portion to minimize speed reduction. However, the sizing of the lumps ensures that passenger vehicles cannot likewise avoid traveling over at least one set of lumps.		FHWA & ITE data indicate an average reduction in operating speeds of 5-9 mph. – Allows emergency vehicles and buses to traverse the device without reducing speed by utilizing the openings provided for those vehicles. – Produces less noise than speed humps for emergency or other large vehicles. – Speed lumps are more accommodating for bicyclists than speed humps, as bicyclists can utilize the openings to traverse the device.	– These devices likewise increase noise to nearby residents for passenger vehicles. – May encourage passenger vehicles to cross into the opposing lane to straddle the humps provided for emergency vehicles. Providing a centerline stripe approaching the speed lump in each travel direction may discourage this.	The estimated cost for a speed lump is similar to a speed hump; approximately $2,000 depending on drainage conditions and materials used.

Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
– Speed Tables				
Speed Tables are similar to speed humps except they incorporate a flat "table" and thus provide an overall gentler transition than the speed hump. The top "flat area' is sized to accommodate the most typical vehicle wheelbase (usually a passenger car) entirely on the top, but can be extended to accommodate other vehicles if desired.		ITE & FHWA indicate an average reduction in operating speeds of about 7 – 9 mph for tables with the dimensions used in the Guide of 22 feet (in the direction of travel). For longer tables ITE indicates a speed reduction of about 4 mph. – Provides a more moderate vertical transition for crossing vehicles and therefore motorists experience less discomfort than when driving over speed humps or lumps	– These devices likewise increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.	The estimated cost for a speed table ranges from $5,000–$15,000 depending on drainage conditions and the materials used.
Raised Crosswalk				
A raised crosswalk is similar to a speed table, except that it utilizes the flat surface to provide a marked pedestrian crossing. A raised crosswalk is placed where there is an existing, marked crosswalk or where one is warranted.		ITE & FHWA indicate an average reduction in operating speeds of about 7 – 9 mph for tables with the dimensions shown in the Guide (22 feet with a top, flat area of 11 feet). – Provides improved visibility and safety for pedestrians. – Enhances the pedestrian environment at pedestrian crossing. – Can increase the number of motorists yielding to pedestrians crossing at the raised device	– These devices likewise increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.	The estimated costs for a raised crosswalk is approximately $5,000 - $7,000, depending on drainage conditions and the type of materials used.
Rumble Strips				
The rumble strip is designed to translate a strong vibration from the road surface, through the tires of the vehicle, and to the driver by means of the steering wheel. This strong tactile sensation forces the driver to a lower speed at the benefit of less vibration through the steering wheel.		– Reduces speeds – Breaks in the strips would allow for bicycles to travel through unprohibited	– Vibrations result in noise – Could be a snow removal obstruction	The estimated costs for a rumble strip installation is $1,000 to $2,000 depending on the types of materials used.
VEHICLE TRAVEL OPTIONS				
One-Way Street Conversions				

Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
One-way street conversion is the act of changing a two-way street into a one-way street. One-way streets operate best in pairs, separate by a block to no more than one-quarter mile.		– Would allow for parking on both sides of the street – Helps to manage traffic patterns – Reduces conflicts – Can simplify pedestrian crossings	– May increase travel speeds. Additional traffic calming measures are recommended to be used with a one-way street conversion to keep speeds low. – Can increase travel time for local residents.	Cost of a one-way street conversion varies greatly depending on how many streets are being converted, what type of traffic control devices need modified, and what type of control devices need added.
Partial Street Closures				
Partial Street Closures are physical barriers that block vehicle travel in one direction for a short distance on an otherwise two-way street. These are typically placed at an intersection with the intent to obstruct selected traffic movements to or from the intersection. A partial closure can block either traffic entering the side street or exiting the side street, depending on its placement.		– Through-traffic is eliminated. – Area for landscaping is provided. – Conflicts are reduced. – Pedestrian safety is increased. – Can include a bicycle pathway connection	– Creates out-of-the way travel for some locals – May inhibit access by emergency vehicles – Will move through traffic to other streets if not back to the arterial. – May experience poor compliance – Bicycle and pedestrian exemptions should be provided as a rule, designed to minimize the likelihood of obstruction by parked vehicles. – All signing should acknowledge the continued existence of the route as a through one for bicyclists and pedestrians.	Cost of a partial street closure is estimated to be between $12,000 and $20,0000, depending on length of closure and materials used.
BICYCLE FACLITIES				
Bicycle Lane - Separated				
Separated Bike Lanes or Cycle Tracks use a combination of horizontal separation (buffer distance) and vertical separation (e.g. flex posts, parked cars, or curbs) to protect people bicycling from motor vehicle traffic. The combination of lateral buffer distance and vertical separation elements (such as flexible delineators, curbs or height differences, or vehicle parking) can ameliorate most of the stressors of on-street bicycling. The robustness of bikeway separation often scales relative to adjacent traffic stress. (Source: NACTO Urban Bikeway Design Guide)		– Dedicates and protects space for bicyclists to improve perceived comfort and safety. – Eliminates risk and fear of collisions with over-taking vehicles. – Reduces risk of ‘dooring’ compared to a bike lane and eliminates the risk of a doored bicyclist being run over by a motor vehicle. – Prevents double-parking, unlike a bike lane. – Low implementation cost by making use of existing pavement and drainage and by using parking lane as a barrier. – More attractive for bicyclists of all levels and ages.	– Streets with parking lanes. – Streets on which bike lanes would cause many cyclists to feel stress because of factors such as multiple lanes, high traffic volumes, high speed traffic, high demand for double parking and high parking turnover. – Streets where conflict at intersections can be effectively mitigated using parking lane setback, markings, and other signalized intersection treatment – Streets with high bicycle volumes. – Streets with high motor vehicle volumes and/or speeds – Desired minimum distance 5-7 feet. – Buffers should be at least 3 feet wide	Cost varies depending on length of implementation.
Bicycle Lane - Buffered				

Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. A buffered bike lane is allowed as per MUTCD guidelines for buffered preferential lanes (section 3D-01). Buffered and Conventional Bicycle Lanes provide organized space for bicycling, and are often part of street reconfiguration projects that improve safety and comfort for all users. Bicycle lanes are an important tool to improve comfort and safety on streets where the number of passing events is too high for comfortable mixed-traffic bicycling, but where curbside activity, heavy vehicles, and lane invasion are not significant sources of conflict. Buffered bike lanes are almost always higher comfort than conventional bike lanes. In many cases, cross-sections with room for buffered bicycle lanes also have room for separated bicycle lanes. (Source: NACTO Urban Bikeway Design Guide).	 	– Provides greater shy distance between motor vehicles and bicyclists. – Provides space for bicyclists to pass another bicyclist without encroaching into the adjacent motor vehicle travel lane. – Encourages bicyclists to ride outside of the door zone when buffer is between parked cars and bike lane. – Provides a greater space for bicycling without making the bike lane appear so wide that it might be mistaken for a travel lane or a parking lane. – Appeals to a wider cross-section of bicycle users. – Encourages bicycling by contributing to the perception of safety among users of the bicycle network.	– On streets with high travel speeds, high travel volumes, and/or high amounts of truck traffic. – On streets with extra lanes or extra lane width. – Special consideration should be given at transit stops to manage bicycle & pedestrian interactions. – Buffers should be at least 18" wide. – Buffer shall be marked with 2 solid white lines with diagonal hatching if 3 feet in width or wider. – Desired minimum width next to on street parking – 5 feet	Cost varies depending on length of implementation.

Bicycle Lane - Conventional

Bike lanes designate an exclusive space for bicyclists through the use of pavement markings and signage. The bike lane is located adjacent to motor vehicle travel lanes and flows in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge, or parking lane. This facility type may be located on the left side when installed on one-way streets, or may be buffered if space permits. See contra-flow bike lanes for a discussion of alternate direction flow. Bike lanes enable bicyclists to ride at their preferred speed without interference from prevailing traffic conditions. (Source: NACTO Urban Bikeway Design Guide)	 	– Increases bicyclist comfort and confidence on busy streets. – Creates separation between bicyclists and automobiles. – Increases predictability of bicyclist and motorist positioning and interaction. – Increases total capacities of streets carrying mixed bicycle and motor vehicle traffic. – Visually reminds motorists of bicyclists' right to the street.	– Most helpful on streets with >= 3,000 motor vehicle average daily traffic. – Most helpful on streets with posted speed >= 25 mph. – On Streets with high transit vehicle volume. – On streets with high traffic volume, regular truck traffic, high parking turnover, or speed limit > 35 mph, consider treatments that provide greater separation between bicycles and motor traffic such – Desirable bike lane = 6 feet (NACTO). Recommended width 5 feet (AASHTO 1999 Guide for Development of Bicycle Facilities) – Desirable ridable surface adjacent to street edge is 4 feet. – 5 foot bike lane could be preferred if concerns with illegal on-street parking	Cost varies depending on length of implementation.

Sharrows (Shared Use Lane Markings)

Type	Images	Benefits	Roadway Impacts	Estimated Implementation Effort and Cost
Shared Lane Markings, or "sharrows," are road markings used to indicate a shared lane environment for bicycles and automobiles. Among other benefits shared lane markings reinforce the legitimacy of bicycle traffic on the street, recommend proper bicyclist positioning, and may be configured to offer directional and wayfinding guidance. The shared lane marking is a pavement marking with a variety of uses to support a complete bikeway network; it is not a facility type and should not be considered a substitute for bike lanes, cycle tracks, or other separation treatments where these types of facilities are otherwise warranted or space permits.		– Encourages bicyclists to position themselves safely in lanes too narrow for a motor vehicle and a bicycle to comfortably travel side by side within the same traffic lane. – Alerts motor vehicle drivers to the potential presence of bicyclists. – Alerts road users of the lateral position bicyclists are expected to occupy within the travel lane. – Indicates a proper path for bicyclists through difficult or potentially hazardous situations, such as railroad tracks. – Advertises the presence of bikeway routes to all users. – Provides a wayfinding element along bike routes. – Demonstrated to increase the distance between bicyclists and parked cars, keeping bicyclists out of the "door zone." – Encourages safe passing by motorists. – Requires no additional street space. – Reduces the incidence of sidewalk riding. – Reduces the incidence of wrong-way bicycling.	Roadway that is not able to be configured to accommodate another, higher level type of bicycle facility. Desirable shared lane marking applications: • To indicate a shared lane situation where the speed differential between bicyclist and motorist travel speeds is very low, such as: – *On bicycle boulevards or similar low volume, traffic calmed, shared streets with a designed speed of < 25 mph.* – *On downhill segments, preferably paired with an uphill bike lane. If space permits, consider a wide downhill bike lane.* – *On streets where the traffic signals are timed for a bicycling travel speed of 12 to 15 miles per hour.* • As a reasonable alternative to a bike lane in limited circumstances: – *Where street width can only accommodate a bicycle lane in one direction. On hills, lanes should be provided in the uphill direction.* – *Within single or multi-lane roundabouts.* – *Along front-in angled parking, where a bike lane is undesirable.* • To strengthen connections in a bikeway network: – *To fill a gap in an otherwise continuous bike path or bike lane, generally for a short distance.* – *To transition bicyclists across traffic lanes or from conventional bike lanes or cycle tracks to a shared lane environment.* – *To direct bicyclists along circuitous routes.*	Cost varies depending on length of implementation.
Neighborhood Greenway (Bicycle Boulevard)				
An enhanced version of signed shared roadways, Bicycle Boulevards are developed through a combination of traffic calming measures and other streetscape treatments, and are intended to slow vehicle traffic while facilitating safe and convenient bicycle travel. Appropriate treatments depend on several factors including traffic volumes, vehicle and bicycle circulation patterns, street connectivity, street width, physical constraints, and other parameters. (Source: NACTO Urban Bikeway Design Guide) Bicycle boulevards are streets with low motorized traffic volumes and speeds, designated and designed to give bicycle travel priority. Bicycle Boulevards use signs, pavement markings, and speed and volume management measures to discourage through trips by motor vehicles and create safe, convenient bicycle crossings of busy arterial streets.	 	– Reduces motor vehicle volumes by completely or partially restricting through traffic on a bicycle boulevard. – Establishes and reinforces bicycle priority by restricting vehicle through movements. – Improves bicyclist comfort on a corridor and benefits pedestrians and residents by reducing traffic volumes along the corridor. – Provides opportunities for landscaping, stormwater management, and other community features such as benches and message boards.	Many local streets with low existing speeds and volumes offer the basic components of a safe bicycling environment. Bicycle boulevards should be designed for motor vehicle volumes under 1,500 vehicles per day (vpd), with up to 3,000 vpd allowed in limited sections of a bicycle boulevard corridor These streets can be enhanced using a range of design treatments, tailored to existing conditions and desired outcomes, to create bicycle boulevards. Design treatments are grouped into measures that provide the following benefits. 1. Route Planning: Direct access to destinations. 2. Signs and Pavement Markings: Easy to find and to follow. 3. Speed Management: Slow motor vehicle speeds. 4. Volume Management: Low or reduced motor vehicle volumes. 5. Minor Street Crossings: Minimal bicyclist delay. 6. Major Street Crossings: Safe and convenient crossings. 7. Offset Crossings: Clear and safe navigation. 8. Green Infrastructure: Enhancing environments	Cost varies depending on what combination of traffic calming measures are implemented.