FEHR PEERS

Memorandum

Date: June 20, 2023

To: Emmanuel Ursu, City of Petaluma

From: Matt Goyne, Geoff Rubendall, Fehr & Peers

Subject: 500 Hopper – Preliminary Traffic Assessment

SF19-1082

This preliminary traffic assessment presents the trip generation results for the 500 Hopper Street project concepts dated March 31, 2023, the number of vehicle trips expected to use the Caulfield Bridge, and a toolbox of design features to help manage cut-through traffic volumes on local residential roadways.

Preliminary Trip Generation Results

Trip generation was calculated based on the minimum and maximum number of units presented in the 500 Hopper unit tables dated March 31, 2023. This would include 285 to 338 units of multi-family residential (3-4 stories) on blocks 6A, 6B, and 7 (for all concepts) and 119 to 169 duplex / townhome on the remaining blocks. Therefore, the minimum scenario would include a total of 404 units (Concept 3: Edge) while the maximum scenario would include up to 507 units (Concept 4: Jan-Mod). The project's trip generation was estimated using the MXD+ methodology for the weekday daily, weekday AM peak hour, and weekday PM peak hour. This methodology is more precise than conventional methods for estimating the number of trips generated by mixed-use projects, such as use of the Institute of Traffic Engineers (ITE) *Trip Generation* Manual, which is based on data derived primarily from single-use and freestanding sites. The MXD+ trip generation methodology, based on Environmental Protection Agency (EPA) and National Cooperative Highway Research Program (NCHRP) research, more precisely estimates trip generation of mixed-use projects by accounting for the travel within the project (i.e., between uses), trips made by non-automobile modes, and the project's land use context. [1] While this approach accounts for a variety of factors noted above, it does not account for transportation

[1] For more information on the MXD+ methodology please visit https://www.fehrandpeers.com/mainstreet/ or see *Getting Trip Generation Right Eliminating the Bias Against Mixed Use Development* by the American Planning Association, May 2013.

demand management (TDM) measures, such as a constrained parking supply, subsidized transit passes, or other incentives to travel by non-auto modes. This would be evaluated within the transportation impact analysis report.

Table 1 presents the project's trip generation results, including the MXD+ trip reductions. As presented in **Table 1**, the project would generate approximately 2,600 to 3,200 daily external vehicle trips, approximately 160 to 200 external vehicle trips during the AM peak hour and approximately 200 to 250 external vehicle trips during the PM peak hour. Approximately eight percent of daily project trips would be non-automobile trips.

Table 1: Minimum and Maximum Concept Trip Generation

Land Use[1]	Trip Generation Estimates							
	Min. Concept				Max. Concept:			
	Units	Daily	AM	PM	Units	Daily	AM	PM
Base Trip Generation Calculation from ITE Trip Generation Manual, 11th Edition								
Attached single-family (ITE Code 215)	119	857	57	68	169	1,237	82	97
Multifamily Housing Low Rise (ITE Code 220)	285	1,921	114	145	338	2,278	135	172
Subtotal	404	2,778	171	213	507	3,515	217	269
MXD+ Trip Reductions								
Internal, Walk, Bike, and Transit Trips		*-219*	*-13*	*-15*		*-295*	*-19*	*-20*
Total External Vehicle Trips		2,559	158	198		3,220	195	249

Notes:
1. For the purposes of this concept, no retail or TDM measures are included within this preliminary trip generation estimate. Small, locally serving retail would serve as an amenity for local residents and any additional traffic generated by the retail or services would likely be off-set by fewer external vehicle trips generated by the project residents.

Sources: ITE *Trip Generation* 11th Edition; Fehr & Peers, 2023.

Vehicle Trip Contribution to Caulfield Bridge

Based on Figure 5 of the *Traffic Impact Study for the Caulfield Bridge and Extension Project* (W-Trans, 2020), there are expected to be approximately 1,500 vehicle trips using the Caulfield Bridge / Southern Crossing under cumulative conditions during the weekday AM and weekday PM peak hours combined. The Caulfield Bridge / Southern Crossing would affect travel for people living along Caulfield Lane, Lakeville Highway, or in West Petaluma and would provide an alternate route to D Street for crossing the Petaluma River for people traveling south of East Washington Street. These forecasts represent a scenario where automobile use and traffic patterns continue

similar to today, and where Caulfield Bridge would be an attractive option to through travel similar to the D Street bridge. The Petaluma General Plan Update is reevaluating the land use and transportation patterns for the future to account for the City's Climate Emergency and other adopted policies.

The distribution of trips based on the Sonoma County Transportation Authority (SCTA) Travel Demand Model indicates that approximately 20 percent of peak hour vehicle trips would be expected to use the Caulfield Bridge / Southern Crossing in the future to travel south to southbound U.S. 101 or drive to destinations surrounding Downtown Petaluma. This would equate to between 40 and 50 peak hour trips, or less than one additional trip per minute during both the weekday AM and PM peak hour. Therefore, the concepts presented in Table 1 would contribute less than four percent to the peak hour traffic volumes using Caulfield Bridge under this future year scenario. For context, traffic volumes typically fluctuate by five to 10 percent on a daily basis[2], so this level of traffic would not represent a substantial contribution for other roadway users.

Traffic Calming Toolbox

The proposed concepts include a variety of street grids that would connect the 500 Hopper project to the existing Riverfront neighborhood and to other areas of Petaluma via Hopper Street, Caulfield Lane, and in the future, the Caulfield Bridge / Southern Crossing. Although the 500 Hopper Street project itself is unlikely to generate a substantial number of vehicle trips on local roadways within Riverfront, the Caulfield Bridge / Southern Crossing is designated as an arterial in the City's General Plan and is expected to serve westside traffic flow. All other internal streets within the 500 Hopper and Riverfront neighborhoods are designated as local streets and would not be designed to accommodate the levels of traffic anticipated for Caulfield Lane. Neighborhood cut-through traffic is a frequent concern for residents such as those in the Riverfront neighborhood and may warrant traffic calming features to deter or discourage through vehicle traffic from using local roadways. Roadway safety issues are often the result of traffic speeds that exceed those of the design speeds, which for local roadways is no higher than 25 miles per hour. **Attachment A** presents a traffic calming toolbox with features that could be considered as a part of the 500 Hopper development project to manage traffic speeds on local roadways and discourage vehicles traveling through the neighborhood from using local roadways for any of the concept street grids.

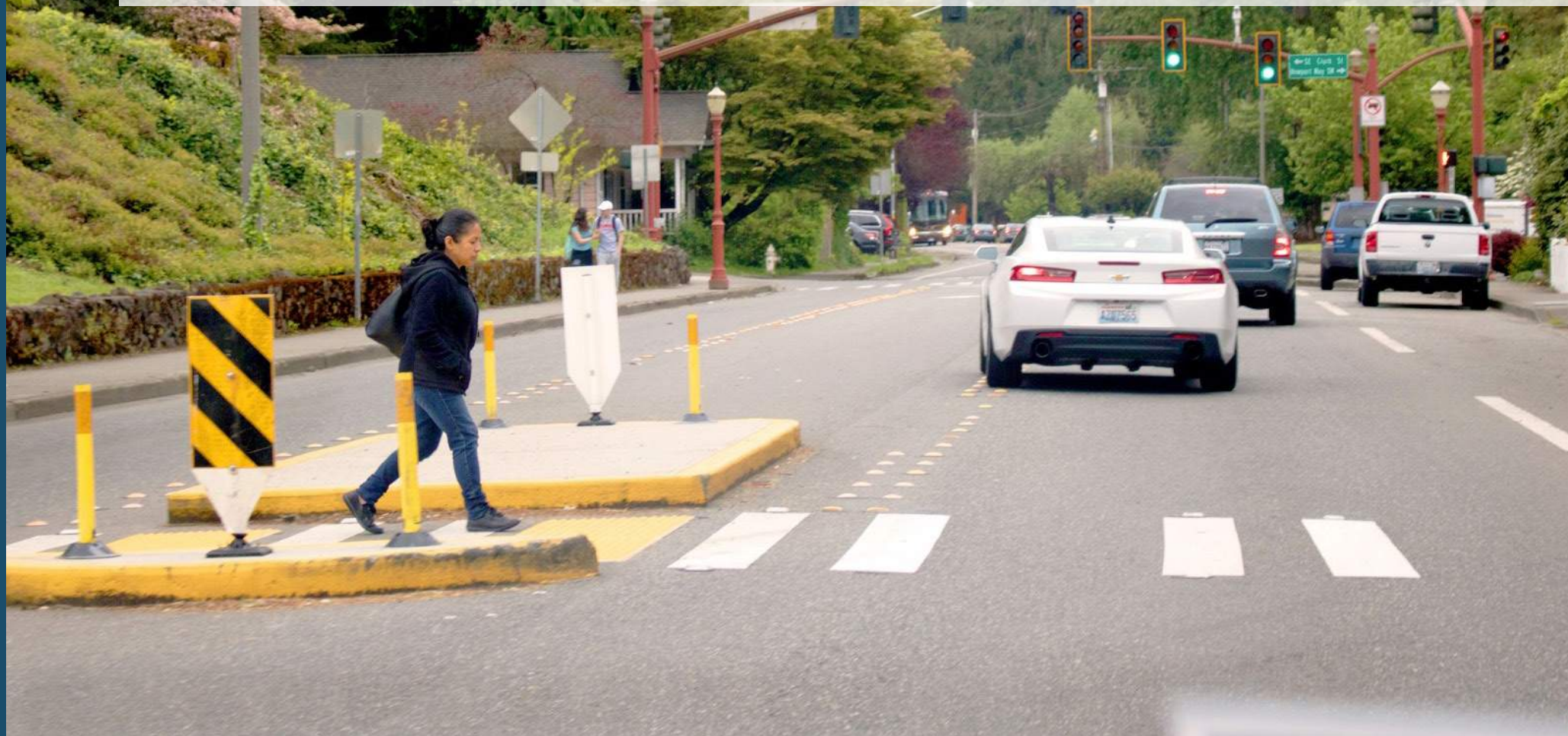
[2] As shown in this blog post, 88 percent of roadways fluctuate by within 10 percent on a daily basis. https://www.fehrandpeers.com/evolving-standard-validation-practices-for-traffic-data/

Attachment A: Traffic Calming Toolbox

TRAFFIC CALMING TOOLBOX

December 2020

FEHR & PEERS




STOP

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01 INTRODUCTION

Background

Traffic problems are an ongoing concern within many communities. Most cities have a steady flow of requests for traffic calming measures to address traffic safety concerns, such as people driving too fast and cutting through neighborhood streets. This resource offers a range of traffic calming measures that can be considered.

Traffic Calming Process

Cities typically have a formal process for how traffic calming devices are implemented. Cities have limited resources and cannot address every complaint or concern. For instance, many cities require an individual or neighborhood to submit a petition form with a minimum number of signatures. Fehr & Peers can help a jurisdiction design a traffic calming process, as done most recently for Issaquah, WA.

Eligible Street Types

Traffic calming devices are typically only eligible on streets classified as local roads and collectors, but some cities only permit them on local roads.

02

TRAFFIC CALMING TOOLBOX

This chapter describes the “toolbox” of devices that are available to community members and cities. The “toolbox” contains 23 different devices that address concerns such as speeding vehicles, high traffic volumes, cut-through traffic, or safety concerns. The devices vary in their ability to treat various traffic-related concerns. Chapter 3 provides guidance on selecting the most appropriate devices given the specific traffic-related concern and street being treated.

The toolbox of traffic management devices is grouped into three categories:

1. Non-Physical devices
2. Speed Control devices
    - Vertical devices
    - Horizontal devices
    - Narrowing devices
3. Volume Control devices

Colors associated with the category of traffic calming measure correspond to the application guideline table in Chapter 3.

For each device in the toolbox, the following discussions are provided:

- Description of the measure
- Photograph and/or schematic
- List of advantages and disadvantages
- Cost estimation

Cost approximations are provided for informational purposes only. Actual costs depend on many factors, including: dimensions of device, construction materials, geographic region, and actual unit/material costs.

Non-Physical Devices

Non-physical devices include any measure that does not require physical changes to the roadway. They are intended to increase drivers' awareness of surroundings and influence driver behavior without physical devices. Because these devices are not self-enforcing, they have limited effectiveness as stand-alone devices and should supplement physical devices.

This category includes the following devices:

- Targeted Speed Enforcement
- Speed Trailer
- Speed Feedback Sign
- Centerline/Edgeline Lane Striping
- Signage
- Education

Targeted Speed Enforcement

Police can perform targeted enforcement at locations where speeding is common. Depending on Police Department resources, the targeted enforcement may be limited in duration. Targeted enforcement may also be used in conjunction with new traffic calming devices to help drivers become aware of the new restrictions.

Equity considerations should be carefully considered to determine if traffic enforcement is appropriate. Automated speed enforcement could be a potential alternative if allowed at the state and local level.

Approximate Cost: Opportunity cost for Police Department resources

ADVANTAGES

- Inexpensive
- Does not physically slow emergency vehicles or buses
- Quick implementation

DISADVANTAGES

- Expensive to maintain an increased level of enforcement
- Effectiveness may be temporary
- Equity concerns given potential for profiling and higher impact to lower income communities.

Speed Trailer

Portable speed trailers visually display drivers' real-time speeds compared to the speed limit. This device serves as an educational tool, as it allows both the driver and other people using the street to observe the actual speeds at which vehicles are traveling. This encourages the driver to adjust their speed in accordance with the speed limit. Speed trailers are not substitutes for permanent actions.

If the technology allows it, the agency can use innovative strategies that give positive reinforcement for adhering to the speed limit. Scotland's automated speed signs show drivers who travel the speed limit a smiley face and message such as "thanks for driving safely."

Approximate Cost: $8,000 - $10,000 per unit

ADVANTAGES

- Relatively low cost
- Quick implementation
- Provides immediate feedback
- Does not require officer to be present
- Can be moved to different locations
- Data can be recorded

DISADVANTAGES

- Effectiveness may be temporary

Source: Lakota Contracting

Speed Feedback Sign

Speed feedback signs measure each approaching vehicle's speed. Real-time speeds are relayed to drivers and flash when speeds exceed the limit. Speed feedback signs are typically mounted on or near speed limit signs and are most common in school zones.

Approximate Cost: $7,000 - $15,000 per sign

ADVANTAGES

- Real-time speed feedback
- Does not physically slow emergency vehicles or buses
- Permanent installation
- Speed and count data can be recorded
- Often solar powered

DISADVANTAGES

- Effectiveness may be temporary
- May require power source or stop working if solar power is insufficient
- Only effective for one direction of travel
- Subject to vandalism

Centerline/Edgeline Lane Striping

Lane striping can be used to create formal bicycle lanes, parking lanes, or edge lines. As a traffic management measure, they are used to narrow the travel lanes for vehicles, thereby inducing drivers to lower their speeds. However, past evidence on speed reductions is inconclusive.

Approximate Cost: $2-3 per linear foot

ADVANTAGES

- Inexpensive
- Can be used to create bicycle lanes or delineate on-street parking
- Does not slow emergency vehicles

DISADVANTAGES

- Has not been shown to significantly reduce travel speeds
- Requires regular maintenance

Signage

Signage that can be used as a traffic management measure include:

- Truck restriction signs
- “Cross traffic does not stop” signs
- Turn restrictions

Turn-movement restrictions involve the use of signs to prevent undesired turning movements without the use of physical devices. The restrictions may generally apply to turning movements in or out of a residential street to a larger street. The turn-movement restrictions may be permanent or only during peak commute hours.

Approximate Cost: $100 - $750 per sign

ADVANTAGES

- Truck restrictions can reduce through truck traffic
- Turn restrictions can reduce cut-through traffic at specific time of day
- Does not slow emergency vehicles or buses
- Can increase safety at an intersection by prohibiting certain turning movements
- Low cost

DISADVANTAGES

- Turn restrictions require enforcement during time of restriction to be effective
- May divert a traffic problem to another street

Education

A variety of education strategies can be used to educate people on the safety risks associated with speeding. Changing driver behavior and attitudes will require increased public safety education. The following strategies can be employed by agencies as funding and Staff resources allow:

- **Brochure -** describe the Traffic Calming Program and process.
- **Traffic Safety newsletter (jurisdiction-wide and/or neighborhood specific) –** provide information on volumes, speeds, speeding fines (particularly in school zones), and average speeds; describe traffic concerns and recommendations; provide reminders of traffic laws and traffic safety tips for all modes.
- **Website –** have a designated page on the agency's website to provide information on the Traffic Calming Program and the same information recommended for the newsletter.
- **Speed yard signs –** implement a public safety education campaign targeting safe speeds. Make yard signs available to the public for free. They should be brightly colored and include phrases like, "20 is plenty," "Keep kids safe," and "SLOW DOWN. Drive like you live here."
- **Permanent roadside memorial signs at fatal crash locations –** install signs to commemorate the lives of loved ones lost. This could include flowers, photos, handmade signs, white bikes (for locations where a bicyclist was killed), and other displays.

Approximate Cost: Varies

ADVANTAGES

- Relatively inexpensive
- Can be implemented incrementally over time

DISADVANTAGES

- Staff time required to maintain these resources

Source: City of Seattle

Speed Control – Vertical Devices

Vertical deflection devices use variations in pavement height and alternative paving materials to physically reduce travel speeds. These devices are designed for travel speeds over the device of approximately 15 to 20 MPH depending on the device. The vertical deflection devices in the toolbox include:

- Speed Lump/Cushion
- Speed Hump
- Speed Table
- Raised Crosswalk

Speed Lump/Cushion

Speed lumps are rounded raised areas placed across the road with two wheel cut-outs designed to allow large vehicles, such as emergency vehicles and buses, to pass with minimal slowing. The design limits passenger cars and mid-size SUVs from fully passing through the cut-outs and requires travel over the lump.

They are slightly less than four inches high, typically parabolic in shape, and have a design speed of 15 to 20 MPH. They are usually constructed with a taper on each side to allow unimpeded drainage between the lump and curb. When placed on a street with rolled curbs or no curbs, bollards are placed at the ends of the speed lump to discourage vehicles from veering outside of the travel lane to avoid the device. A series of speed lumps are often needed to retain slower speeds over a longer distance.

Approximate Cost: $3,000 - $5,000

ADVANTAGES

- Effective in reducing speeds
- Maintains rapid emergency response times
- Relatively easy for bicyclists to cross

DISADVANTAGES

- Maintenance and snow removal can be challenging
- Vehicles with wide wheel base can pass through the lump using the wheel cut-outs
- Increased noise from vehicles accelerating

Speed Hump

Speed humps are rounded raised areas placed across the road, but unlike speed lumps, they do not have cut-outs for large vehicles and bicycles. They are typically 3-3.5 inches high, typically parabolic in shape, and have a design speed of 15 to 20 MPH. A series of speed humps are often needed to retain slower speeds over a longer distance.

Speed humps are typically not used on transit routes due to their effect on transit operations and passenger comfort.

Approximate Cost: $3,000 - $5,000

ADVANTAGES

- Effective in reducing speeds

DISADVANTAGES

- Slows down emergency vehicles and buses
- Maintenance and snow removal can be challenging
- Increased noise
- More difficult for bicyclists to cross

Speed Table

Speed tables are flat-topped speed humps approximately 22 feet long, which is typically long enough for the entire wheelbase of a passenger car to rest on top. Their long flat fields, plus ramps that are more gently sloped than speed lumps, give speed tables higher design speeds than lumps and thus may be more appropriate for streets with higher ambient speeds. Concrete is the preferred material. Stamped concrete can give the appearance of brick or other textured materials, which would improve the appearance of speed tables, draw attention to them, and may enhance safety and speed reduction.

Approximate Cost: $3,000 - $5,000

ADVANTAGES

- Effective in reducing speeds, though not to the extent of speed lumps
- Maintenance easier than speed lumps
- Slightly higher design speed compared to speed lumps makes them compatible with collector streets and on grades

DISADVANTAGES

- Increased noise

Source: XFXL

Raised Crosswalk

Raised crosswalks are speed tables striped with crosswalk markings and signage to channelize pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists. Stamped concrete can give the appearance of brick or other textured materials, which would improve the appearance of speed tables, draw attention to them, and may enhance safety and speed reduction.

Approximate Cost: $5,000 - $15,000

ADVANTAGES

- Effective in reducing speeds, though not to the extent of speed lumps
- Maintenance easier than speed lumps
- Improve safety for both vehicles and pedestrians

DISADVANTAGES

- Increased noise
- Impact to drainage needs to be considered

Speed Control – Horizontal Devices

Horizontal deflection devices use raised islands to eliminate straight-line paths along roadways and through intersections. The horizontal deflection devices in the toolbox include:

- Traffic Circle
- Roundabout (Single Lane)
- Median with Horizontal Deflection
- Slow Turn Wedges
- Hardened Centerlines/Rubber Speed Bumps

Traffic Circle

Traffic circles are raised islands, placed in intersections, around which traffic circulates. Stop signs or yield signs can be used as traffic controls at the approaches of the traffic circle. Circles prevent drivers from speeding through intersections by impeding the straight-through movement and forcing drivers to slow down to yield. Depending upon the size of the intersection and circle, trucks may be permitted to turn left in front of the circle, and the agency can use mountable curbs if turn radii are a concern for emergency vehicles and/or trucks.

Approximate Cost: $10,000 - $25,000

ADVANTAGES

- Very effective in moderating speeds and improving safety
- Can have positive aesthetic value

DISADVANTAGES

- If not designed properly, difficult for emergency vehicles or large trucks to travel around
- Must be designed so that the circulating traffic does not encroach on crosswalks
- Potential loss of on-street parking

Roundabout (Single Lane)

Like traffic circles, roundabouts require traffic to circulate counterclockwise around a center island. But unlike circles, roundabouts are used on higher volume streets to allocate right-of-way among competing movements. They are found primarily on collector streets, often substituting for traffic signals. They are larger than neighborhood traffic circles, have raised splitter islands to channel approaching traffic to the right, and do not have stop signs. Due to large amount of required right-of-way and construction costs, roundabouts may be most appropriate for new developments or redevelopment areas.

Approximate Cost: $150,000 - $1 million, depending on materials used, amount of curb work required, and size of existing intersection

ADVANTAGES

- Enhanced safety compared to a traffic signal or stop sign
- Minimizes queuing at approaches to the intersection
- Less expensive to operate than traffic signals
- Can have positive aesthetic value
- Shorter pedestrian crossing distance

DISADVANTAGES

- May require major reconstruction of an existing intersection
- Loss of on-street parking
- Continuous flow of traffic limits opportunity for pedestrians to cross (compared to signal)
- May present additional obstacles to visually impared pedestrians

Medians with Horizontal Deflection

Medians are raised islands placed in the middle of the roadway around which traffic circulates. Medians do not always have horizontal deflection. To meet this definition, a median must extend into the travel lane to eliminate the straight-line path and force drivers to slow down to navigate the curve.

Approximate Cost: $10,000 - $15,000

ADVANTAGES

- Effective in moderating speeds and improving safety
- Where pedestrian crossing activity is expected, can provide two-stage crossing opportunities
- Can have positive aesthetic value

DISADVANTAGES

- Can increase potential for fixed object collisions
- Potential loss of on-street parking

Slow Turn Wedges

Slow turn wedges use markings and flexible plastic posts to buffer pedestrians from traffic and shrink the area where they could get hit by a car.

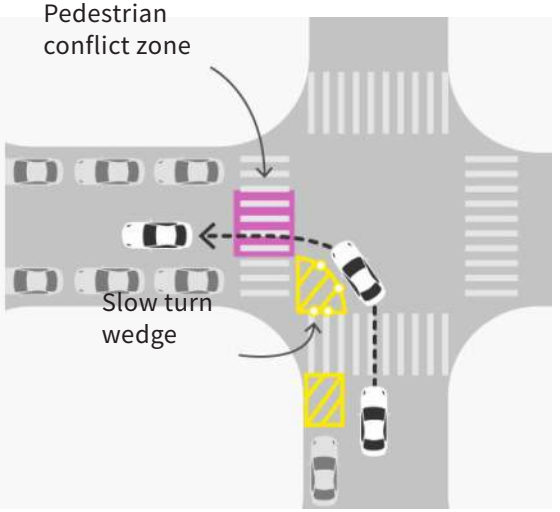
Approximate Cost: $1,000 - $3,000

ADVANTAGES

- Effective in reducing speeds and conflicts with pedestrians/bicyclists
- Discourages drivers from cutting corners and encourages following the proper path when making left turns
- Low cost

DISADVANTAGES

- Potentially limited to one-way streets
- Less durable than raised concrete islands



Sources: qz.com and NYC DOT

Hardened Centerlines/Rubber Speed Bumps

Hardened centerlines are bollards that prevent left-turners from crossing the centerlines to make a turn. Pedestrian islands can also accomplish the same goal if they are placed strategically, with the added benefit of being more durable and providing refuge for walkers.

Rubber speed bumps are often used in conjunction with hardened centerlines and placed in an intersection. There are a variety of design configurations.

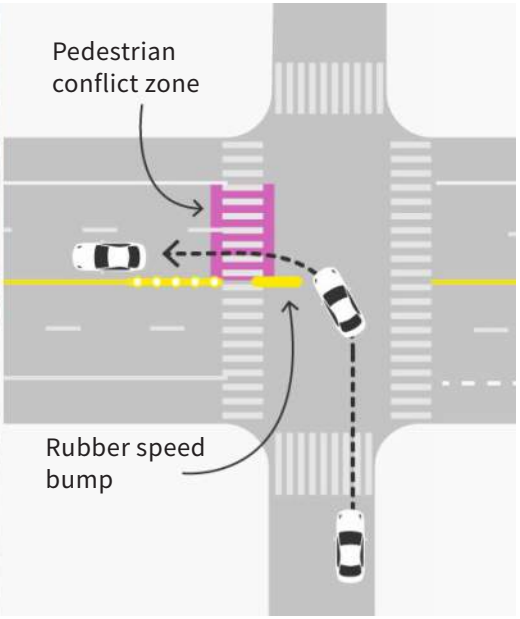
Approximate Cost: $2,000 - $4,000

ADVANTAGES

- Effective in reducing speeds and conflicts with pedestrians/bicyclists
- Discourages drivers from cutting corners and encourages following the proper path when making left turns
- Low cost

DISADVANTAGES

- Less durable than raised concrete islands



Sources: qz.com and NYC DOT

Speed Control – Narrowing Devices

Narrowing devices use raised islands, curb extensions, and other treatments to narrow the travel lane for motorists. They are not as effective as vertical or horizontal devices, but can still provide traffic calming. The narrowing devices in the toolbox include:

- Bulb-Out/Curb Extension
- Two-Lane Choker
- Median Without Horizontal Deflection/Pedestrian Refuge Island
- Street Trees

Bulb-Out/Curb Extension

Bulb-outs and curb extensions extend the sidewalk into the parking lane to narrow the roadway at intersections. Their effectiveness in calming traffic is limited by the absence of vertical or horizontal deflection, but they can still be beneficial. Bulbouts can make intersections more pedestrian friendly by shortening the crossing distance and decreasing the curb radii, thus reducing turning vehicle speeds. Both of these effects increase pedestrian comfort and safety at the intersection.

Approximate Cost: $20,000 - $100,000 per device, depending on the amount of drainage and grading work. Can be constructed without blocking existing gutter.

ADVANTAGES

- Reduces pedestrian crossing distance and exposure to vehicles
- Through and left-turn movements are easily negotiable by large vehicles
- Creates protected on-street parking bays
- Reduces speeds (especially right-turning vehicles)

DISADVANTAGES

- Effectiveness is limited by the absence of deflection
- May slow right-turning emergency vehicles
- Potential loss of on-street parking

Two-Lane Choker

Chokers are curb extensions at midblock that narrow a street. Chokers leave the street cross section with two lanes that are narrower than the normal cross section. Their effectiveness in calming traffic is limited by the absence of vertical or horizontal deflection, but they can still be beneficial.

Approximate Cost: $20,000 - $60,000 depending on the amount of drainage and grading work. Can be constructed without blocking existing gutter.

ADVANTAGES

- Easily negotiable by emergency vehicles and buses
- Can have positive aesthetic value
- Reduces speeds

DISADVANTAGES

- Effect on vehicle speeds is limited by the absence of vertical or horizontal deflection
- May require bicyclists to briefly merge with vehicular traffic
- Loss of on-street parking
- Build-up of debris in gutter

Median Without Horizontal Deflection/Pedestrian Refuge Island

Medians are raised islands placed in the middle of the roadway around which traffic circulates. Medians without horizontal deflection do not extend into the travel lane, maintaining a straight-line path for drivers. While they are not as effective as medians with horizontal deflection, they can still be beneficial. They can act as pedestrian refuges, increasing pedestrian safety, and provide aesthetic benefits.

Approximate Cost: $10,000 - $20,000

ADVANTAGES

- Can increase pedestrian safety
- Can have positive aesthetic value
- Reduces speeds

DISADVANTAGES

- Effect on vehicle speeds is limited by the absence of vertical or horizontal deflection
- Potential loss of on-street parking

Street Trees

Trees placed along streets can potentially help reduce motor vehicle speeds and collisions, though studies show mixed results. Streets lined with trees or with landscaped center medians can affect driver perception of lane width, called an "edge effect". Street trees require irrigation in arid climates.

Approximate Cost: Varies by region, but average planting cost is $250 - $650 per tree

ADVANTAGES

- Low cost
- Positive aesthetic value and placemaking
- Reduces speeds, though studies limited
- Environmental benefits like reduced flooding and carbon emissions
- Shade enhances pedestrian experience

DISADVANTAGES

- Requires maintenance

Source: University of Washington

Volume Control Devices

Diversion devices use raised islands and curb extensions to preclude particular vehicle movements, such as left turn or through movements, usually at an intersection. The volume control devices in the toolbox include:

- Full Closure
- Half Closure
- Diagonal Diverter
- Forced-Turn Island

Full Closure

Full street closures are barriers placed across a street to close the street completely to through traffic, usually leaving only sidewalks or bicycle paths open. The barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or any other obstructions that leave an opening smaller than the width of a passenger car. Emergency vehicles are accommodated via removable bollards or similar devices.

Approximate Cost: $10,000 - $300,000 depending on the materials used

ADVANTAGES

- Very effective in reducing cut-through traffic volumes
- Able to maintain pedestrian and bicycle connectivity
- Can be designed to maintain access for emergency vehicles

DISADVANTAGES

- Causes circuitous routes for local residents
- Diverts traffic to another street

Half Closure

Half closures (or partial street closures) are barriers that block travel in one direction for a short distance on otherwise two-way streets. Partial closures are often used in sets to make travel through neighborhoods with “gridded” streets circuitous rather than direct.

Approximate Cost: $10,000 - $200,000 depending on the materials used

ADVANTAGES

- Able to maintain two-way bicycle access
- Effective in reducing traffic volumes

DISADVANTAGES

- Causes circuitous routes for local residents
- May limit access to businesses
- Drivers can bypass the barrier
- Diverts traffic to another street

Source: FHWA Safety

Diagonal Diverter

Diagonal diverters are barriers placed diagonally across an intersection, blocking through movement. Like half closures, diagonal diverters are usually staggered to create circuitous routes through neighborhoods.

Approximate Cost: $10,000 - $300,000 depending on the materials used

ADVANTAGES

- Reduces traffic volumes
- Able to maintain full pedestrian and bicycle access

DISADVANTAGES

- Causes circuitous routes for local residents
- Delays for emergency services
- May require reconstruction of corner curbs

Forced-Turn Island

Forced-turn islands are raised islands that prohibit certain movements on approaches to an intersection.

Approximate Cost: $10,000 - $20,000

ADVANTAGES

- Can improve safety at an intersection by prohibiting critical turning movements
- Reduces traffic volumes

DISADVANTAGES

- If designed improperly, drivers can maneuver around the island to make an illegal movement
- May divert a traffic problem to a different street

Forced-turn islands in Palo Alto, CA. Source: NACTO

03

APPLICATION GUIDELINES

This chapter provides guidance on selecting the most appropriate traffic calming device for a specific problem. This involves narrowing the toolbox of traffic calming devices to those that: most closely target the key traffic issue, are appropriate for the type of location concerned, are cost effective, and are compatible with the traffic volumes, geometrics, and adjacent land uses near the given location.

When the list has been narrowed, devices should be selected based on effectiveness and likelihood of consensus among affected residents. Finally, the selected devices need to be placed in a manner that will produce the desired results.

STEP 1:

Address the Traffic-Related Concern

The first task when selecting the most appropriate traffic calming device is to narrow the field of considered devices to those that address the primary traffic concern. The most common traffic-related concerns are:

- Speeding – motor vehicle speeds are too high
- Traffic Volumes – motor vehicle usage levels (all trips or non-local trips) are too high
- Vehicle Safety – motor vehicle speeds or volumes create a safety concern

Each device in the toolbox is appropriate to a different subset of the above traffic-related concerns. The appropriateness of each device (which accounts for how effective a device is in that context) is summarized in **Table 1**.

STEP 2:

Address the Location Type

The appropriate device for a given problem is also a function of the location. Special consideration should be given when considering measures located on streets preferred by the Fire Department when responding to emergencies.

Table 2 indicates the location(s) where each type of traffic calming measure is applicable.

STEP 3:

Address Other Constraints by Street Type

The third step in determining the most appropriate device is to consider how each device is compatible with the street classification, street grade, traffic volumes, posted speeds, and special roadway users. **Table 3** illustrates where each device is appropriate under certain conditions.

In general, roadway width is not a constraint for implementing physical measures. Speed lumps, speed tables, and raised crosswalks can be constructed across any reasonable roadway width. Traffic circles require a specific amount of distance within the intersection to be properly designed.

Table 1: Applicability and Efficacy of Devices by Traffic-Related Concerns

Types of Measures	Types of Traffic-Related Concerns		
	Speeding	Traffic Volumes*	Collisions
Non-Physical Measures			
Targeted Speed Enforcement	●	○	◠
Speed Trailer	●	○	○
Speed Feedback Sign	●	○	○
Centerline/Edgeline Lane Striping	●	○	○
Signage	●	◠	◠
Education	◠	◠	◠
Speed Control - Vertical Measures			
Speed Lump/Cushion	●	○	◠
Speed Hump	●	○	◠
Speed Table	●	○	◠
Raised Crosswalk	●	○	◠
Speed Control - Horizontal Measures			
Traffic Circle	●	◠	●
Roundabout (Single Lane)	●	◠	●
Median with Horizontal Deflection	●	◠	●
Slow Turn Wedges**	●	◠	●
Hardened Centerlines/Rubber Speed Bumps**	●	◠	●

● Strongly Appropriate ◠ Moderately Appropriate ○ Inappropriate

* Depends largely on availability of alternate routes

** More info available at: https://www1.nyc.gov/html/dot/html/pedestrians/turn-calming.shtml; https://www1.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf

Types of Measures	Types of Traffic-Related Concerns		
	Speeding	Traffic Volumes*	Collisions
Speed Control - Narrowing Measures			
Bulb-Out/Curb Extension	◓	○	●
Two-Lane Choker	◓	○	●
Median without Horizontal Deflection/Pedestrian Refuge Island	◓	○	●
Street Trees	◓	○	○
Volume Control Measures			
Full Closure	◓	●	●
Half Closure	◓	●	●
Diagonal Diverter	◓	●	●
Forced-Turn Island	○	●	◓

● Strongly Appropriate ◓ Moderately Appropriate ○ Inappropriate

* Depends largely on availability of alternate routes

Table 2: Applicability of Devices by Location Type

Types of Measures	Local Streets		Collectors*	
	Mid-block	Intersection	Mid-block	Intersection
Non-Physical Measures				
Targeted Speed Enforcement	●	●	●	●
Speed Trailer	●	X Distraction	●	X Distraction
Speed Feedback Sign	●	X Distraction	●	X Distraction
Centerline/Edgeline Lane Striping	●	X	●	X
Signage	●	●	●	●
Education	●	●	●	●
Speed Control - Vertical Measures				
Speed Lump/Cushion	●	X	◠	X
Speed Hump	●	X	◠	X
Speed Table	●	X	●	X
Raised Crosswalk	●	◠	●	◠
Speed Control - Horizontal Measures				
Traffic Circle	X	●	X	●
Roundabout (Single Lane)	X	◠	X	●
Median with Horizontal Deflection	●	◠	●	◠
Slow Turn Wedges	X	◠	X	◠
Hardened Centerlines/Rubber Speed Bumps	X	◠	X	●

● Generally applicable ◠ Seldom, except in some cases X Never applicable

*Due to emergency response concerns

Types of Measures		Local Streets		Collectors*	
		Mid-block	Intersection	Mid-block	Intersection
Speed Control - Narrowing Measures					
	Bulb-Out/Curb Extension	X	●	X	●
	Two-Lane Choker	●	X	●	X
	Median without Horizontal Deflection/ Pedestrian Refuge Island	●	●	●	●
	Street Trees	●	X	●	X
Volume Control Measures					
	Full Closure	X	●	X	X
	Partial Closure	X	●	X	◓
	Diagonal Diverter	X	●	X	X
	Forced-Turn Island	X	◓	X	◓

● Generally applicable ◓ Seldom, except in some cases X Never applicable

*Due to emergency response concerns

Table 3: Applicability of Devices by Street Type

Types of Measures		Street Types	
		Local Streets	Collectors
Non-Physical Measures			
	Targeted Speed Enforcement	No limitations with respect to ADT or speed	
	Speed Trailer		
	Speed Feedback Sign		
	Centerline/Edgeline Lane Striping		
	Signage		
	Education		
Speed Control - Vertical Measures			
	Speed Lump/Cushion	Speed Limit ≤ 25 MPH; Grade ≤ 8%	
	Speed Hump		
	Speed Table	Daily Entering Volume <16,000; Speed Limit ≤ 35 MPH	
	Raised Crosswalk*		
Speed Control - Horizontal Measures			
	Traffic Circle	Daily Entering Volume <10,000; Speed Limit ≤ 35 MPH	
	Roundabout (Single Lane)	Daily Entering Volume <16,000; Speed Limit ≤ 45 MPH	
	Median with Horizontal Deflection	No limitations with respect to ADT or speed	
	Slow Turn Wedges		
	Hardened Centerlines/Rubber Speed Bumps		

* Not appropriate for streets without curbs, gutters, or sidewalks

Types of Measures	Street Types	
	Local Streets	Collectors
Speed Control - Narrowing Measures		
Bulb-Out/Curb Extension	ADT ≤ 20,000; Speed Limit ≤ 35 MPH	
Two-Lane Choker		
Median without Horizontal Deflection/Pedestrian Refuge Island*		
Street Trees	No limitations with respect to ADT or speed, but sight lines must be preserved	
Volume Control Measures		
Full Closure	Proper evaluation should be conducted to determine amount of diverted traffic to alternate routes	
Partial Closure		
Diagonal Diverter		
Forced-Turn Island		

* Not appropriate for streets without curbs, gutters, or sidewalks