

Traffic Calming Primer

City of Thunder Bay

February, 2017

Prepared by:

MORR
TRANSPORTATION CONSULTING



Guidance to Users

This document provides a foundation of knowledge on common traffic calming measures that are implemented across North America which could be applied in Thunder Bay. The Traffic Calming Primer is intended to provide readers with an overview of traffic calming, the potential benefits and disadvantages of applying traffic calming measures, and important considerations in their application.

Contents

WHAT IS TRAFFIC CALMING?	1
WHAT ARE POTENTIAL BENEFITS OF TRAFFIC CALMING?	1
WHAT ARE POTENTIAL DISADVANTAGES OF TRAFFIC CALMING?.....	1
WHEN IS TRAFFIC CALMING APPLIED?	2
WHERE IS TRAFFIC CALMING APPLIED?.....	2
HOW IS TRAFFIC CALMING APPLIED?.....	3
TRAFFIC CALMING MEASURES	4
VERTICAL DEFLECTION MEASURES	7
HORIZONTAL DEFLECTION MEASURES	17
ACCESS RESTRICTION	31
ADDITIONAL CONSIDERATIONS.....	39
REFERENCES AND ADDITIONAL READING	43

The Primer does not provide specific details on traffic calming policy or specific traffic calming measure design details. Users are encouraged to consult the "Additional Reading" section at the back of this Primer for literature regarding traffic calming policy, warrants, and design.

What is Traffic Calming?

Traffic calming measures are mainly physical measures that reduce the negative effects of motorized traffic to improve the safety and quality of life within a neighbourhood. Traffic calming restores roadways to their intended function through implementation of self-enforcing measures that:

- *Reduce vehicle speeds* to improve the safety for all road users and reduce traffic noise levels.
- *Reduce vehicle through traffic* to decrease conflicts between vehicles and vulnerable road users (pedestrians and cyclists), reduce air pollution, and reduce traffic noise. When possible, network wide transportation improvements are preferred to neighbourhood traffic calming.

What are Potential Benefits of Traffic Calming?

Traffic calming measures reduce vehicle speeds and volumes to achieve the following potential benefits:

- *Improve safety* by minimizing the number of conflicts and severity of collisions between road users, and increase motorist awareness of vulnerable road users. Lower vehicle speeds provide more reaction time for motorists to avoid collisions and reduce impact speeds if a collision is unavoidable. Fewer vehicles reduce the number of possible conflicts with other road users.
- *Improve the neighbourhood environment* by reducing the amount of air pollution and noise pollution caused by motorized traffic. Additionally, traffic calming measures may provide the opportunity for landscaping and public art installations, which enhances the streetscape.

What are Potential Disadvantages of Traffic Calming?

Traffic calming measures may result in the following:

- Increased travel time for emergency vehicles and buses.
- Diverted traffic onto adjacent roadways (shifting the problem).
- Reduced or less direct neighbourhood access points.
- Increased difficulty in maintenance activities (e.g., snow clearing).



When is Traffic Calming Applied?

The traffic calming measures presented in this *primer* can be applied to *reactively* calm traffic on existing roadways where vehicular speed and volume issues have been identified. However, many of these measures can also be used to *proactively* enhance the safety and liveability of future planned neighbourhoods by including them early in the neighbourhood design process. Proactive implementation of traffic calming measures in neighbourhood design is preferred to reactive implementation to promote safety and quality of life for all road users (i.e., motorists, pedestrians, and cyclists).

Where is Traffic Calming Applied?

Traffic calming measures are typically applied at a neighbourhood level, which includes roadways classified as local and collector roadways. Some traffic calming measures are also effective when implemented on arterial roads. However, traffic calming on arterial roads is less often desired because the primary function of arterial roads is to move traffic within the transportation network. Table 1 provides details on how roadways are classified by the City of Thunder Bay.

TABLE 1: CITY OF THUNDER BAY FUNCTIONAL ROADWAY CLASSIFICATION.

Road Class						
Local	Primary function: land access. Truck routes prohibited. Sidewalks only if required. Low vehicle volumes.	40 - 50	permitted	20 minimum, 20 desired	2	0 - 3,000
Minor Arterial	Primary function: traffic movement. Truck routes permitted. Sidewalks on both sides if required.	50 - 60	generally permitted	20 minimum, 30 desired	2 - 4	5,000 - 15,000

Source: City of Thunder Bay. *Engineering and Development Standards*. (2016)

How is Traffic Calming Applied?

Traffic calming is generally applied by following a detailed procedure defined by a municipality specific *traffic calming policy* (see side bar). While each municipality often develops a unique traffic calming policy for their needs, there are general principles that apply to all. These are:

- *Involve the community* to build public support early in the process.
- *Identify the problem* to ensure the appropriate solution is chosen. Residents have difficulty differentiating excessive speeds with excessive volumes.
- *Quantify the problem* to prioritize traffic calming applications. This includes quantifying the spatial extent and time period of the problem.
- *Prioritize improvements to network transportation issues* to mitigate the need for neighbourhood traffic calming while improving network traffic flow (i.e., arterial improvements may reduce cut-through traffic).
- *Apply traffic calming measures neighbourhood-wide* to ensure that problems are not displaced elsewhere in the neighbourhood.
- *Avoid restricting access points* to circumvent unwanted public backlash.
- *Implement self-enforcing measures* to negate the need for police enforcement.
- *Do not impede vulnerable road users* to support the goals of traffic calming.
- *Consider all services* to minimize delay and impact on services such as transit and emergency services (e.g., police, ambulance, and fire).
- *Monitor and evaluate treatments* to enhance the credibility of traffic calming and track performance of various measures.

Traffic Calming Policy

Traffic calming policies are developed by municipalities to objectively assess requests for traffic calming. They are procedural documents that provide specific warrant criteria that must be met throughout the process. Common procedures and warrants included in traffic calming policies are:

1. *Public request/petition.*
Traffic calming is typically considered when resident support is proven through a petition, public meeting, or survey.
2. *Safety review.*
Warrants may include the collision rate, presence of sidewalks, maximum road grade, or emergency services accommodation.
3. *Technical review.*
Warrants may include minimum speed, minimum and maximum traffic volume, minimum block length, and transit accommodation.
4. *Area resident survey.*
A minimum percent of area residents must accept the proposed measures.
5. *Approval.*
Traffic calming measures are implemented if all the warrants are met or exceeded.

Traffic Calming Measures

Traffic calming measures are grouped into the following:

- vertical deflection,
- horizontal deflection, and
- access restriction.

In general, each type of traffic calming measure has specific benefits (reduced vehicle speeds and/or reduced vehicle through traffic) and mitigates certain disadvantages (access restrictions, emergency and transit vehicle impediment, enforcement needs, and maintenance issues).

Table 2 lists traffic calming measures included in this *primer*. For each traffic calming measure, the table shows the applicable road class, potential to reduce speeds, potential to reduce vehicle volumes, potential to reduce conflicts, and relative costs.



LEGEND	
 Reduces vehicle speed.	 Does not impede transit and emergency vehicles.
 Reduces vehicle through traffic.	 Self-enforcing.
 No access restrictions.	 Does not affect maintenance.

Vertical Deflection

Vertical deflection measures result in an abrupt change in pavement height that causes driver discomfort if their speed exceeds the deflection design speed as they travel over it.



primary benefits



secondary benefits

Horizontal Deflection

Horizontal deflection measures utilize raised islands and curb extensions to prevent vehicles from travelling in straight travel paths at excessive speeds.



primary benefits



secondary benefits

Access Restriction

Access restriction measures include physical obstructions that restrict vehicles from entering roads or traveling in directions where access was previously allowed.



primary benefits



secondary benefits

TABLE 2: COMMON TRAFFIC CALMING MEASURES

	Measures	Applicable Road Type	Potential Benefits			Relative Cost	Page Number
			Reduced Speed	Reduced Volume	Reduced Conflicts		
Vertical Deflection	Speed hump	L,C	●	⊙	●	\$	8
	Speed cushion	L,C	●	⊙	●	\$	9
	Speed table	L,C	●	⊙	●	\$	10
	Speed kidney	L,C	●	⊙	●	\$	11
	Raised crosswalk	L,C	●	⊙	⊙	\$	12
	Raised intersection	L,C	⊙	⊙	⊙	\$\$\$	13
	Sidewalk extension	L	⊙	○	⊙	\$	14
	Textured crosswalk	L,C	○	○	⊙	\$	15
Horizontal Deflection	Chicane, one-lane	L,C	●	●	●	\$\$	18
	Chicane, two-lane	L,C	⊙	○	⊙	\$\$	19
	Curb radius reduction	L,C,A	⊙	○	○	\$\$	20
	Curb extension - intersection (bulb-out)	L,C,A	⊙	○	○	\$\$	21
	Curb extension - midblock (choker)	L,C	⊙	○	⊙	\$\$	22
	Lane narrowing	L,C,A	⊙	○	⊙	\$	23
	On-street parking	L,C,A	⊙	⊙	○	\$	24
	Lateral Shift	L,C,A	⊙	○	○	\$\$\$	25
	Lane reduction (road diet)	L,C,A	⊙	○	⊙	\$\$	26
	Raised median island	L,C,A	⊙	○	⊙	\$\$	27
	Traffic circle	L,C	●	⊙	⊙	\$\$	28
	Roundabout	L,C,A	⊙	○	⊙	\$\$\$	29
Access Restriction	Intersection channelization	L,C,A	○	⊙	⊙	\$\$	32
	Raised median through intersection	L,C	○	●	⊙	\$\$	33
	Right-in/right-out island	L,C	○	●	⊙	\$\$	34
	Diverter	L,C	○	●	⊙	\$\$\$	35
	Directional closure	L,C	○	●	⊙	\$\$	36
	Full closure	L	○	●	●	\$\$\$	37

LEGEND

Applicable Road Type

L	local
C	collector
A	arterial

Potential Benefits

○	negligible
⊙	minor
●	substantial

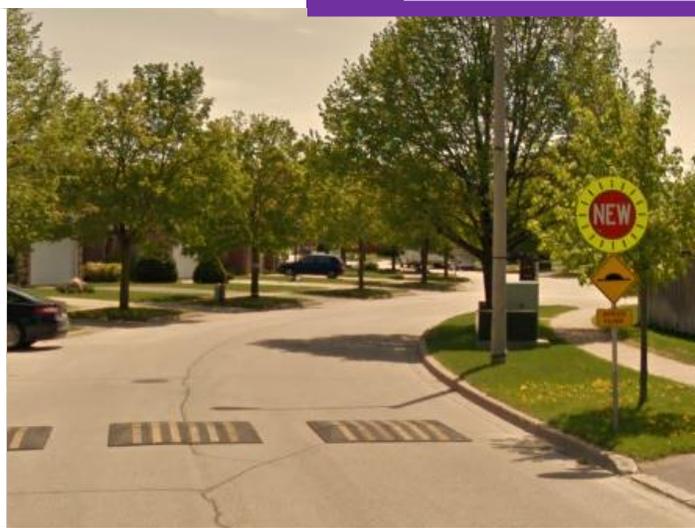
Relative Cost

\$	low
\$\$	moderate
\$\$\$	high

Vertical Deflection Measures

Vertical deflection measures result in an abrupt change in pavement height that causes driver discomfort if their speed exceeds the deflection design speed as they travel over it. In general, these measures are effective at reducing vehicle speeds and the number of conflicts but do not have a substantial effect on vehicle volumes. These measures are not recommended for arterial roads, where there are higher vehicle speeds and volumes compared to local and collector roads.

<i>Vertical Deflection Measures</i>	<i>pg</i>
SPEED HUMP	8
SPEED CUSHION.....	9
SPEED TABLE.....	10
SPEED KIDNEY	11
RAISED CROSSWALK	12
RAISED INTERSECTION	13
SIDEWALK EXTENSION	14
TEXTURED CROSSWALK.....	15



SPEED HUMP

Vertical Deflection

Speed humps are a vertical structure spanning across the width of a roadway (excluding gutters) designed to slow vehicle speeds. Motorist discomfort is related to the size of the speed hump and the speed they are travelling. Speed humps are typically installed in series along a local or collector road.

Advantages

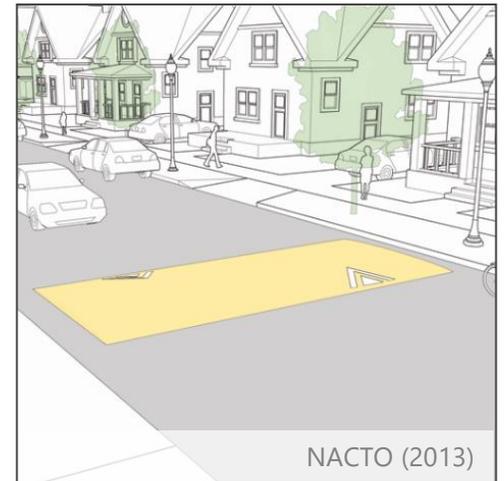


- Low cost.
- Vehicle speeds are reduced.
- Number of collisions are reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Emergency and transit vehicle speeds are reduced.
- May be damaged by snow plows.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	◎
Reduced Conflicts	●

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	

SPEED CUSHION

Speed cushions are a narrower version of a speed hump and are installed in the middle of each travel lane. They are generally six feet wide and designed to slow passenger vehicles while allowing vehicles with larger wheel bases (emergency vehicles and buses) to pass unimpeded. Speed cushions should be considered rather than speed humps on emergency response and transit routes.

Advantages

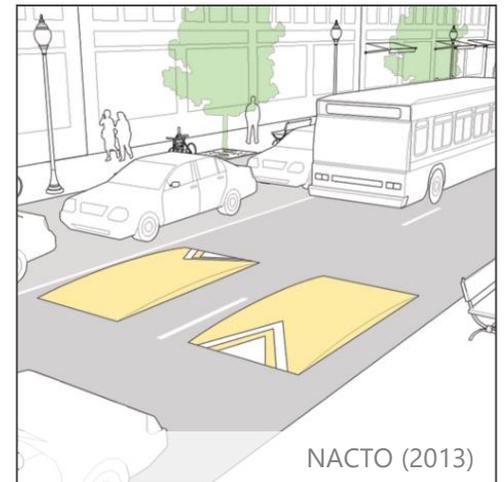


- Passenger vehicle speeds are reduced.
- Emergency and transit vehicles are not impeded.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- May be damaged by snow plows.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	◎
Reduced Conflicts	●

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Speed tables are speed humps with an extended flat top that can typically fit the length of a passenger vehicle across its width. Speed tables have higher design speeds than speed humps. They are installed to reduce speeds on local and collector roads while maintaining a smoother ride for larger vehicles.

Advantages



- Vehicle speeds are reduced, but not as effectively as with speed humps.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- More expensive than speed humps.
- Emergency and transit vehicle speeds are reduced, although less than with speed humps.
- May be damaged by snow plows.



Relative Cost



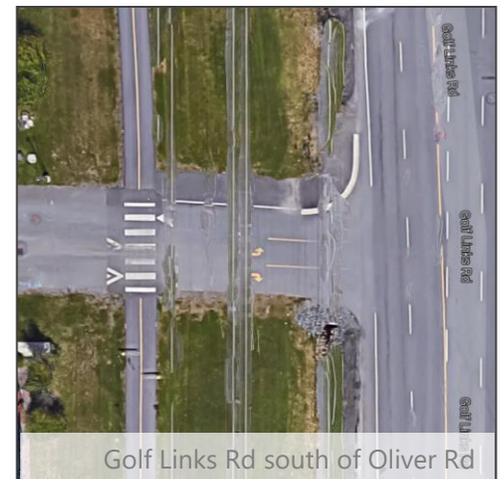
Potential Benefits

Reduced Speed	●
Reduced Volume	◎
Reduced Conflicts	●

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Speed kidneys comprise three separate curvilinear humps that run parallel to the direction of travel. Vehicles can slow and drive over the kidney or they can slow and maneuver along the curvilinear shaped outer hump to negate any potential mechanical damage to their vehicle. Transit and emergency vehicles can travel in a straight path without contacting the speed kidney. These measures are suitable for local and collector roads.

Advantages

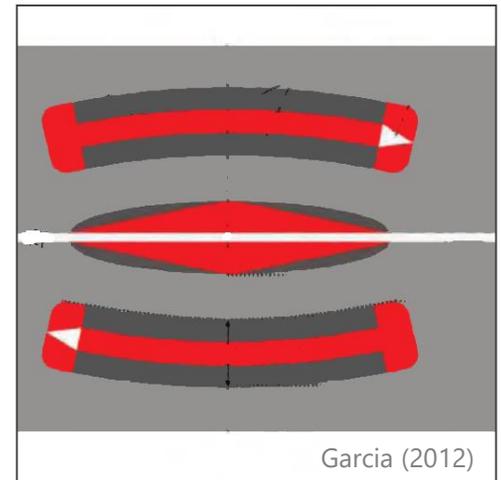


- Vehicle speeds are reduced.
- Emergency vehicles and buses are not impeded.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Vehicle damage is minimized.

Disadvantages



- May be damaged by snow plows.
- On-street parking may be reduced.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	⊙
Reduced Conflicts	●

○ Negligible ⊙ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



RAISED CROSSWALK

Vertical Deflection

Raised crosswalks are similar to speed humps except they are typically wider and have a flat top. The elevation and width of the raised crosswalk matches the sidewalk approaches on either side of the roadway. In this way, raised crosswalks help increase pedestrian conspicuity for motorists. These measures are suitable for all types of crosswalks (marked, unsignalized, mid-block, and intersection).

Advantages

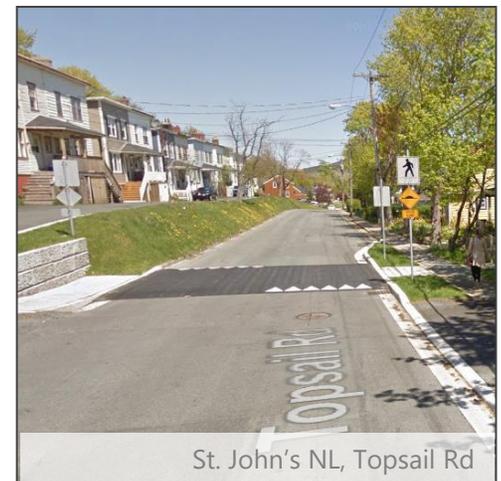


- Vehicle speeds are reduced, but not as effectively as with speed humps.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Vehicle speeds are slower through pedestrian conflict area.
- Pedestrian crossing area is better defined.

Disadvantages



- More expensive than speed humps.
- Emergency and transit vehicle speeds are reduced, although less than with speed humps.
- Pedestrians may have a false sense of security.
- May be damaged by snow plows



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	⊙
Reduced Conflicts	⊙

○ Negligible ⊙ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	

RAISED INTERSECTION

Raised intersections have a flat, elevated area between all approaching roadways of an intersection, similar to raised crosswalks and speed tables. However, the reduction in vehicle speeds is minor compared to raised crosswalks, speed humps, and speed tables due to the relatively large distance between access and egress ramps. Raised intersections alert drivers of pedestrians crossing through intersections. These measures are generally implemented at the intersection of low speed local and collector roads with no more than 2-lanes.

Advantages



- Vehicle speeds are reduced, but not as effectively as with speed humps.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Vehicle speeds are slower through pedestrian conflict area.
- Pedestrian crossing area is better defined.

Disadvantages



- More expensive than raised crosswalks, speed humps, and speed tables.
- Emergency and transit vehicle speeds are reduced, less than with speed humps.
- Pedestrians may have a false sense of security.
- May be damaged by snow plows.
- May adversely affect street drainage.

Relative Cost



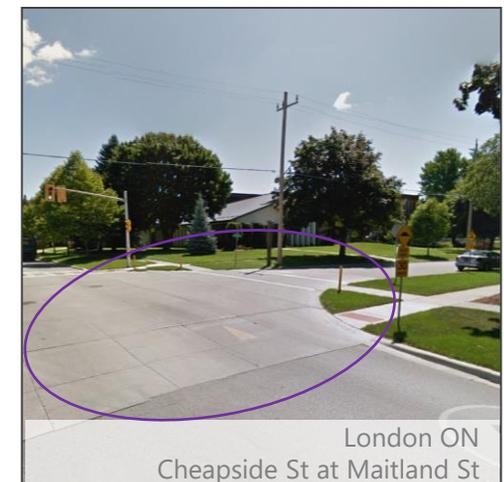
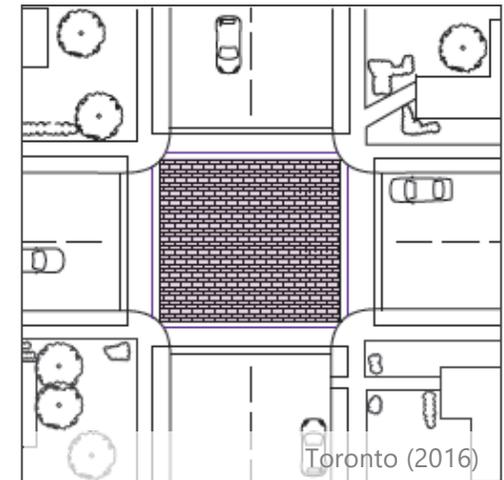
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Sidewalk extensions are sidewalks that have been extended across a local road that intersects with a collector or arterial. Sidewalk extensions can be 'raised,' meaning the sidewalk elevation is maintained like raised crosswalks. Unraised sidewalk extensions can be used if sufficient boulevard space does not exist for ramps. In this case, they are simply a continuation of the sidewalk material that visually highlights the crosswalk to motorists.

Advantages



- Vehicle speeds are reduced, but not as effectively as with speed humps.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Vehicle speeds are reduced through pedestrian conflict area.
- Pedestrian crossing area is better defined.

Disadvantages



- More expensive than speed humps.
- Emergency and transit vehicle speeds are reduced, less than speed humps.
- May be damaged by snow plows.
- Pedestrians may have a false sense of security.

Relative Cost



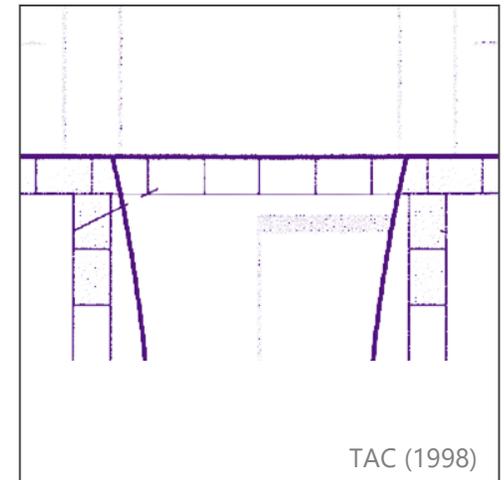
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	
Arterials	



TEXTURED CROSSWALK

Vertical Deflection

Textured crosswalks may have a different colour and/or surface texture than the roadway to highlight the pedestrian crossing area and reduce the number of conflicts. The conspicuity of the colour and texture reduces over-time as they wear out. Textured crosswalks are generally used on local and collector roads.

Advantages



- Pedestrian crossing area is better defined and more visible to approaching motorists.
- Streetscape aesthetics are improved.

Disadvantages



- Vehicles speeds may not be reduced.
- May be damaged by snow plows.
- Pedestrians may have a false sense of security.
- Traffic noise may be created from textured pavement.
- Stability of pedestrians with mobility aids may be hindered.

Relative Cost



Potential Benefits

Reduced Speed	○
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ◉ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Horizontal Deflection Measures

Horizontal deflection measures cause a lateral shift on an otherwise linear roadway that causes motorists to slow their speeds to maneuver through a curvilinear travel path. They also include measures that narrow the travel lanes, which causes motorists to slow down because of the perception that they are travelling too fast. In general, these measures are used to reduce speeds but have minimal effect on reducing vehicle through traffic. Horizontal deflection measures are primarily applied to local and collector roads and may be applicable to arterial roads in some instances.

<i>Horizontal Deflection Measures</i>	<i>pg</i>
CHICANE, ONE-LANE	18
CHICANE, TWO-LANE	19
CURB RADIUS REDUCTION	20
CURB EXTENSIONS – INTERSECTIONS	21
CURB EXTENSIONS – MIDBLOCK	22
LANE NARROWING	23
ON-STREET PARKING	24
LATERAL SHIFT	25
LANE REDUCTION (ROAD DIET).....	26
RAISED MEDIAN ISLAND	27
TRAFFIC CIRCLE.....	28
ROUNDBOUT	29



CHICANE, ONE-LANE

Horizontal Deflection

Chicanes are curb extensions that alternate from one side of the road to the other. In general, a series of three or more curb extensions are used to force vehicles to slow down and travel in an S-shaped path through the chicane. A one-lane chicane narrows a two-lane roadway into the width of one-lane, requiring one vehicle to yield if two vehicles arrive at the same time in opposite directions. They are most effective on local roads with regular traffic in both directions to minimize opportunity for motorists to drive down the center unimpeded.

Advantages



- Vehicle speeds are reduced.
- Vehicle through traffic is reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Streetscape aesthetics may be improved.

Disadvantages



- Two-way vehicle conflicts may be increased.
- Emergency and transit vehicle speeds are reduced.
- May be damaged by snow plows.
- On-street parking space is reduced.

Relative Cost



Moderate

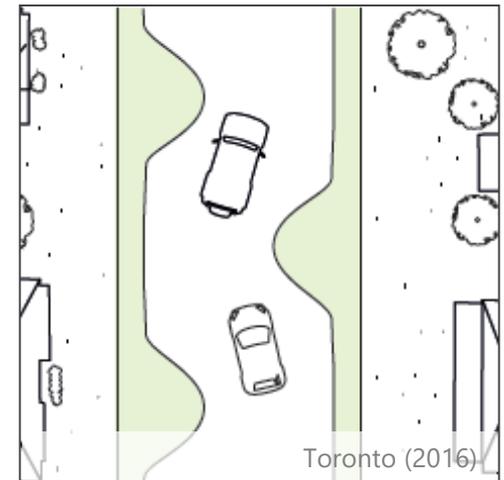
Potential Benefits

Reduced Speed	●
Reduced Volume	●
Reduced Conflicts	●

○ Negligible ◐ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Toronto (2016)



Seattle WA, NW 55th St

CHICANE, TWO-LANE

Horizontal Deflection

Chicanes are curb extensions that alternate from one side of the road to the other. In general, a series of three or more curb extensions are used to force vehicles to slow down and travel in an S-shaped path through the chicane. Two-lane chicanes allow vehicles to remain in their travel lane. They are not as effective at reducing vehicle speeds as one-lane chicanes and may not reduce vehicle volumes. The safety benefits of reduced vehicle speeds may be offset by an increased potential for conflict as motorists have been found to cross the road centerline to maintain a straight trajectory.

Advantages

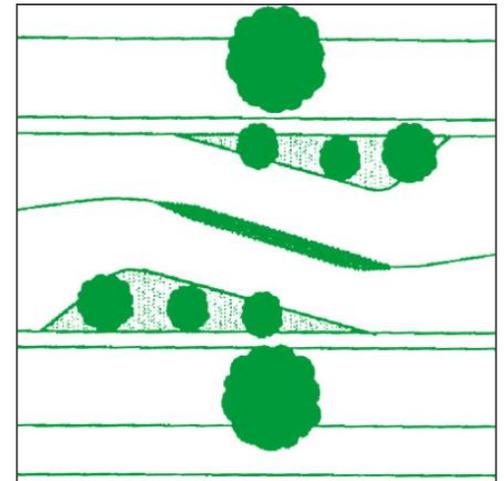


- Vehicle speeds are reduced.
- Vehicle through traffic is reduced, but not as effectively as with one-lane chicanes.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Improves aesthetics of streetscape.

Disadvantages



- Two-way vehicle conflicts may be increased.
- Emergency and transit vehicle speeds are reduced.
- May be damaged by snow plows.
- On-street parking space is reduced.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Halifax NS, Romans Ave

CURB RADIUS REDUCTION

Horizontal Deflection

A curb radius reduction is a reconstruction of an intersection corner with a smaller radius, generally between 3 and 5 meters. A smaller corner radius requires vehicles to slow their speed to make a right turn but may make right turns difficult for larger vehicles. In addition, they reduce the distance pedestrians must walk from curb to curb in a crosswalk. Curb radius reductions may be used on local, collector, and arterial roads.

Advantages



- Reduces right turning vehicle speeds.
- Pedestrian crossing distance is reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Emergency and transit vehicles may have difficulty making right turns.
- Large vehicles may have to cross into the on-coming traffic lane to complete a right turn.
- Large vehicles may mount the curb posing a safety risk to pedestrians.

Relative Cost



Moderate

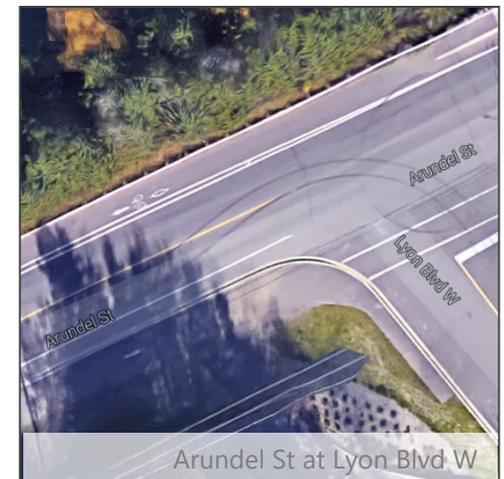
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	○

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



CURB EXTENSION - INTERSECTION

Horizontal Deflection

Intersection curb extensions or bulb-outs, reduce the width of the roadway at intersections. They are used to reduce conflicts between pedestrians and vehicles and their severity by shortening pedestrian crossing distance, increasing pedestrian visibility, and by reducing vehicle speeds. Curb extensions are not preferred by cyclists as they may be forced into conflict with passing vehicles. They may be installed on local roads, collectors, and at intersections with arterials.

Advantages

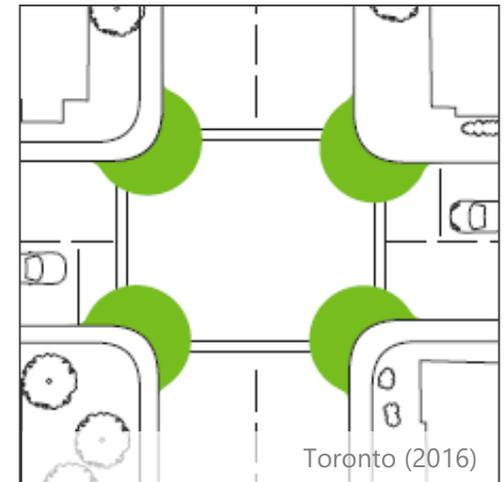


- Vehicle speeds are reduced through pedestrian conflict area.
- Pedestrian crossing distance is reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.
- Vehicles are prevented from parking too close to intersections.

Disadvantages



- Cyclists may feel forced into traffic flow.
- Snow clearing activities may be impeded.
- On-street parking space may be reduced.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	○

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



CURB EXTENSION - MIDBLOCK

Horizontal Deflection

Midblock curb extensions or chokers, reduce the width of the roadway at midblock locations by reconstructing the roadway curbs closer together. They are used to reduce vehicle speeds, thus reducing the severity of a collision should one occur. Curb extensions are not preferred by cyclists as they may be forced into conflict with passing vehicles. Midblock curb extensions may be installed on local and collector roads.

Advantages

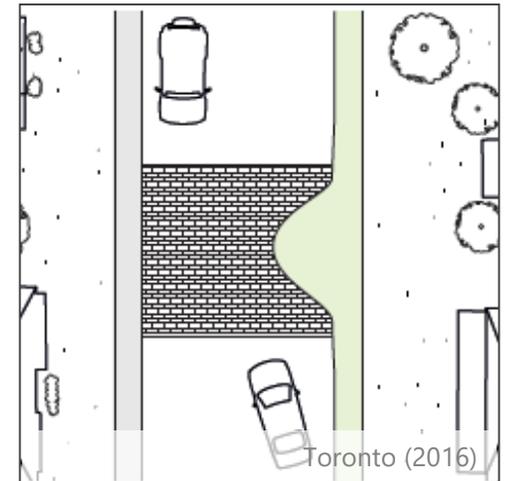


- Vehicle speeds are reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Cyclists may feel forced into traffic flow.
- On-street parking space may be reduced.



Relative Cost



Moderate

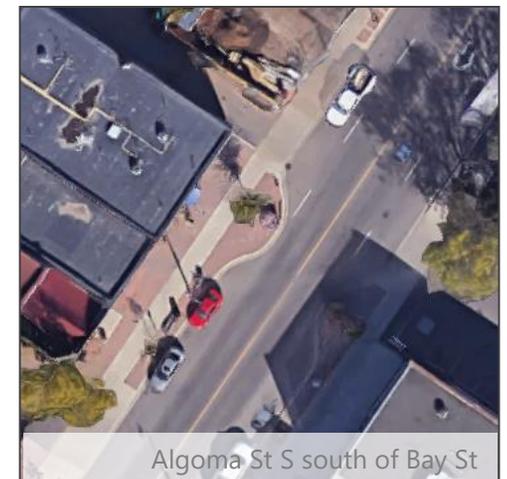
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



LANE NARROWING

Horizontal Deflection

Lane narrowing is the reduction of lane width using painted lines that may be supplemented with bollards, raised curbs, or other physical delineation to make the lane width feel smaller to motorists. The additional roadway space can be used to add bike lanes, widen sidewalks, or widen the median. Lane narrowing is typically applied to local and collector roads but may be used on arterial roads.

Advantages

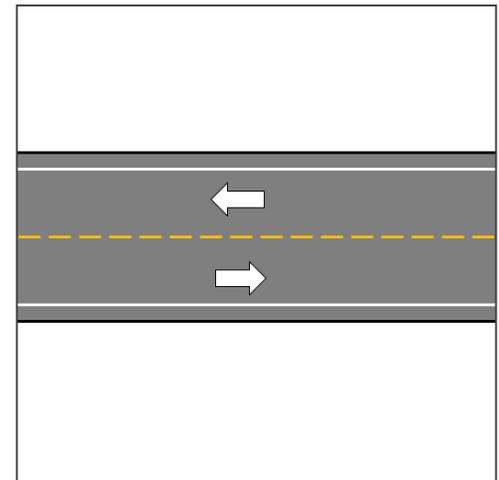


- Vehicle speeds are reduced.
- Pedestrian crossing distance is reduced.
- Emergency and transit vehicles are not impeded.
- Enforcement activities are not required.
- Local access points are not obstructed

Disadvantages



- Two-way vehicle conflicts may be increased.
- On-street parking space is reduced.



Relative Cost



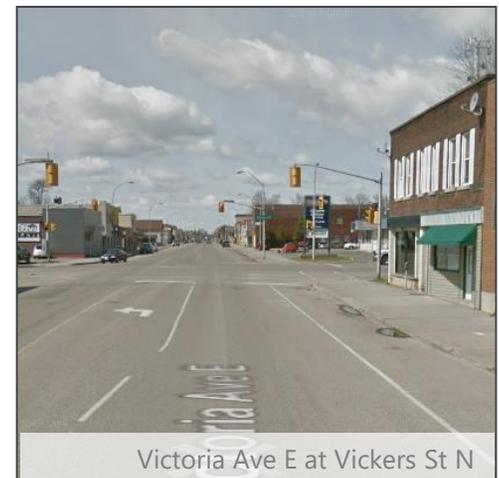
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



On-street parking reduces the effective roadway width by allowing vehicles to park along the curb lane. Angle parking is not used for this purpose due to the increased potential for conflicts. On-street parking is recommended for local and collector roads with a maximum roadway width of 10 m; vehicles speeds may not be reduced on wider roadways because motorists are less likely to feel constrained by the parked vehicles.

Advantages

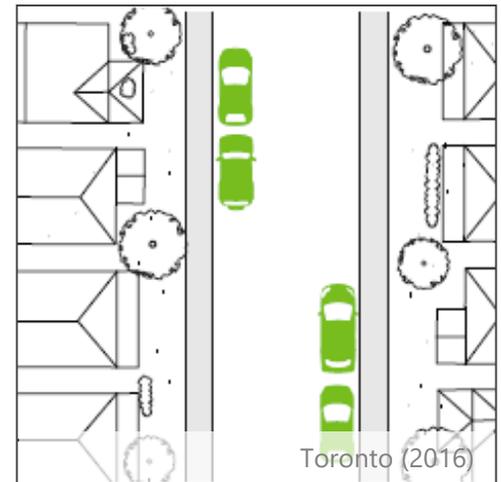


- Vehicle speeds are reduced.
- Vehicle through traffic may be decreased.
- Enforcement activities are not required.
- Local access points are not obstructed.
- On-street parking is increased.

Disadvantages



- Visibility of crossing pedestrians may be reduced.
- Cyclist dooring potential is increased.
- Snow clearing activities may be impeded.



Relative Cost



Low

Potential Benefits

Reduced Speed	●
Reduced Volume	●
Reduced Conflicts	○

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



LATERAL SHIFT

Horizontal Deflection

Lateral shifts are curb extensions that shift the travel lane once and require motorists to change their travel path. Their ability to reduce speeds significantly has not been proven. Painted lines can be used rather than curb extensions to reduce costs but they may not be as effective at reducing vehicle speeds. In addition to local and collector roads, they can be used on arterial roads with higher vehicular speeds and volumes than local and collector roads.

Advantages

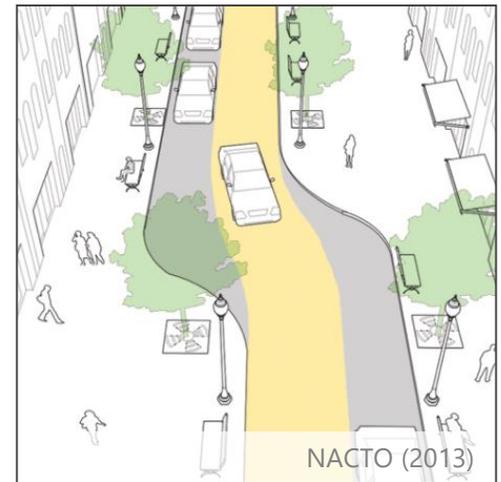


- Vehicle speeds may be reduced.
- Emergency vehicles and buses are not impeded significantly.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Vehicles speeds may not be reduced.



Relative Cost



Potential Benefits

Reduced Speed	⊙
Reduced Volume	○
Reduced Conflicts	○

○ Negligible ⊙ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



LANE REDUCTION (ROAD DIET)

Horizontal Deflection

Lane reduction, also referred to as a road diet, involves the removal of a travel lane. Traffic analysis should be conducted to verify that future vehicles volume will not exceed the reduced roadway capacity to minimize vehicle re-routing. The most common application is reducing four lane arterial roadways to three lanes, with one travel lane in each direction and a centre, bi-directional left-turn lane (FHWA, 2014). The additional space can be used to add parking, add bike lanes, widen sidewalks, or widen the median. Road diets can be implemented on local, collector, and arterial roads.

Advantages



- Vehicle speeds are reduced.
- Vehicle-vehicle conflicts are reduced.
- Emergency and transit vehicles are not impeded.
- Enforcement activities are not required.
- On-street parking may be increased.

Disadvantages



- Two-way vehicle conflicts may be increased.
- Detailed traffic analysis may be required.

Relative Cost



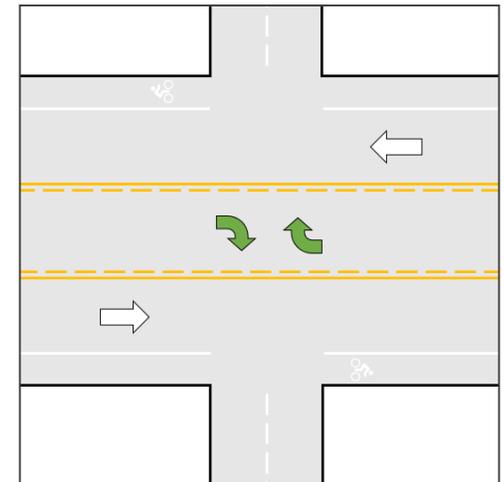
Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



RAISED MEDIAN ISLAND

Horizontal Deflection

Raised median islands are a physical barrier located in the median between directions of traffic on a two-way roadway. Median islands narrow the roadway causing motorists to slow down. They may be used as a pedestrian crossing refuge and are applied to local and collector roads.

Advantages

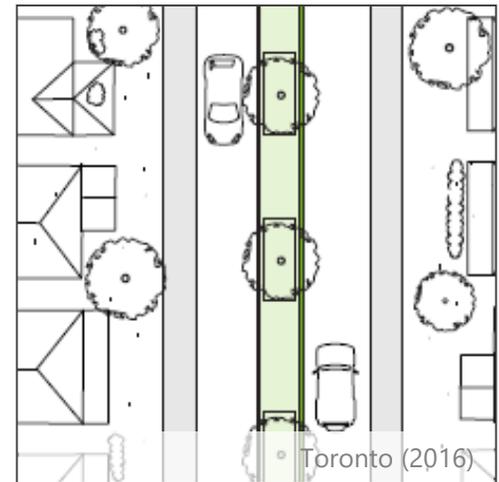


- Vehicle speeds are reduced.
- Enforcement activities are not required.
- Pedestrian-vehicle conflicts are reduced if refuge is provided.

Disadvantages



- Driveway access may be restricted for one direction of travel.
- Vehicle speeds may be increased if left-turns are no longer possible.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓



Traffic circles are raised islands located in the centre of an intersection that motorists navigate around in a counter-clockwise direction. They typically include a truck apron on the outer circumference to enable the passage of large vehicles. However, buses and emergency vehicles may be permitted to travel clockwise to make a left turn if there is not enough space in the intersection and legislation permits this maneuver. Traffic circles are used on local and collector roads.

Advantages



- Vehicle-vehicle conflicts are reduced.
- Vehicle speeds are reduced.
- Vehicle through traffic is reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Bicycle-vehicle conflicts may be increased.
- Emergency and transit vehicle speeds are reduced and may have to make left turns in the opposite direction of traffic flow.
- Pedestrians may have a false sense of security.



Relative Cost



Moderate

Potential Benefits

Reduced Speed	●
Reduced Volume	◎
Reduced Conflicts	◎

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Roundabouts are raised islands located in the centre of an intersection that motorists navigate around in a counter-clockwise direction. They also include median islands on all approaches to guide vehicles into the roundabout and may include a truck apron on the outer island circumference to enable the passage of transit and emergency vehicles. Roundabouts are often implemented on arterial roads where higher speeds are tolerable.

Advantages

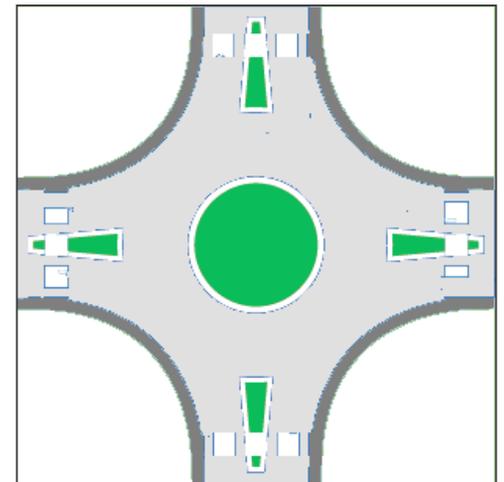


- Vehicle-vehicle conflicts are reduced.
- Vehicle speeds are reduced.
- Enforcement activities are not required.
- Local access points are not obstructed.

Disadvantages



- Bicycle-vehicle conflicts may be increased.
- Emergency and transit vehicle speeds are reduced.
- Visually impaired pedestrians may have increased difficulty crossing the intersection.



Relative Cost



Potential Benefits

Reduced Speed	●
Reduced Volume	○
Reduced Conflicts	●

○ Negligible ● Minor ● Substantial

Applicable Road Class

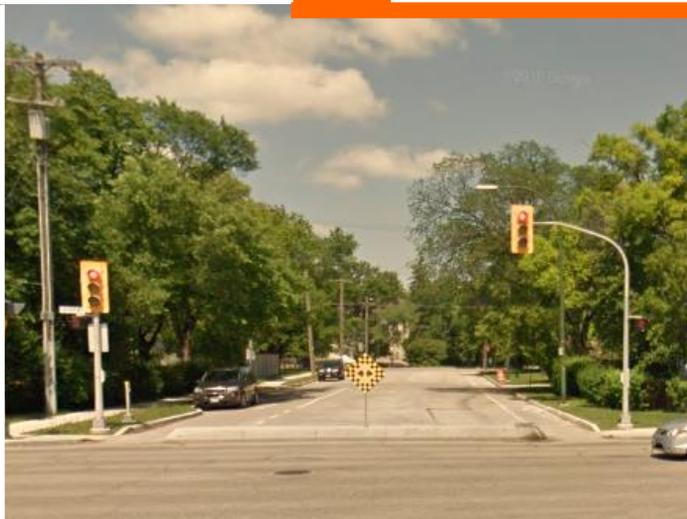
Locals	✓
Collectors	✓
Arterials	✓



Access Restriction

Access restriction measures physically obstruct vehicles from entering or egressing roadways. These measures are the most severe traffic calming tool and should only be considered if vertical and horizontal deflection measures have been found to be ineffective. Vehicular through traffic is reduced by prohibiting specific turning movements or all access to and from local and collector roads. It is important that these measures restrict vehicle access only and do not impede pedestrian and cyclist flow.

<i>Access Restriction Measures</i>	<i>pg</i>
INTERSECTION CHANNELIZATION	32
RAISED MEDIAN THROUGH INTERSECTION	33
RIGHT-IN/RIGHT-OUT ISLAND	34
DIVERTER.....	35
DIRECTIONAL CLOSURE	36
FULL CLOSURE	37



INTERSECTION CHANNELIZATION

Access Restriction

Intersection channelization deploys raised islands at an intersection to physically direct traffic through an intersection and obstruct undesirable movements. Channelization can decrease pedestrian crossing distance and is typically designed to allow cyclists to pass unimpeded. These measures are applicable on local, collector, and arterial roads.

Advantages

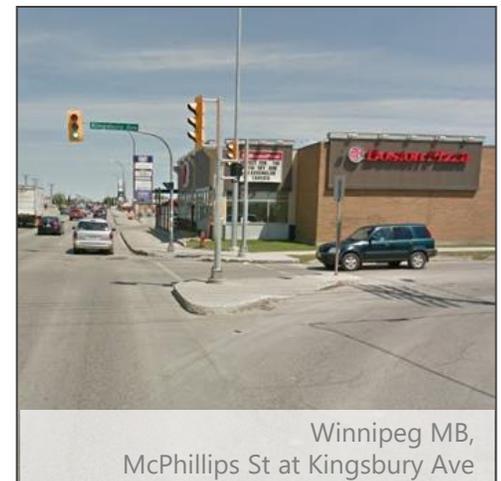
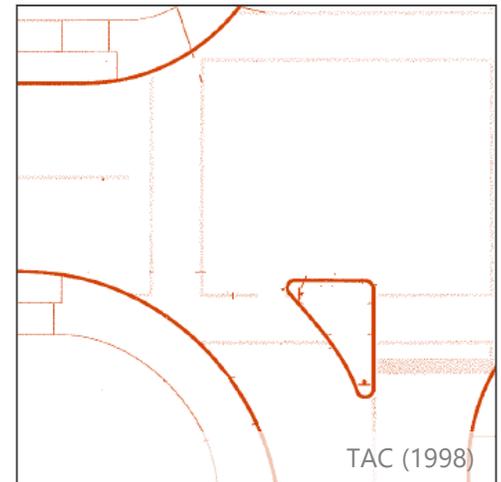


- Vehicle through traffic is reduced.
- Vehicle traffic is prohibited, for specific turning movements.
- Pedestrian crossing distance is reduced.
- Enforcement activities are not required.
- Obstruction may be circumvented by emergency vehicles.

Disadvantages



- Local access points are restricted.
- Raised islands may be circumvented by vehicles if volumes are low.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.



Relative Cost



Moderate

Potential Benefits

Reduced Speed	○
Reduced Volume	◉
Reduced Conflicts	●

○ Negligible ◉ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	✓

RAISED MEDIAN THROUGH INTERSECTION

Access Restriction

A raised median through an intersection runs along the major roadway centreline, preventing vehicles from crossing the major roadway. Cuts in the median allow cyclists and pedestrian to pass unimpeded or seek refuge while crossing the roadway. This measure is generally installed along collector or arterial roads to restrict left turns and thru movements from intersecting local and collector roads.

Advantages

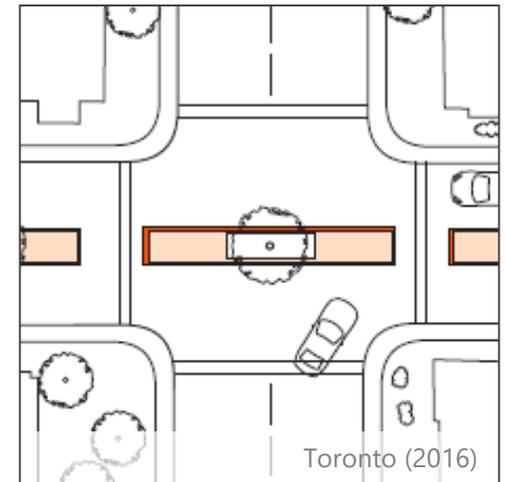


- Vehicle through traffic is reduced.
- Vehicle traffic is prohibited, for specific turning movements.
- Enforcement activities are not required.
- Obstruction may be circumvented by emergency vehicles.

Disadvantages



- Local access points are restricted.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.



Relative Cost



Moderate

Potential Benefits

Reduced Speed	○
Reduced Volume	●
Reduced Conflicts	◎

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



RIGHT-IN/RIGHT-OUT ISLAND

Access Restriction

Right-in/right-out islands are raised islands that force vehicles to make a right turn at an intersection. These islands prevent vehicles from accessing specific local roads and collectors.

Advantages

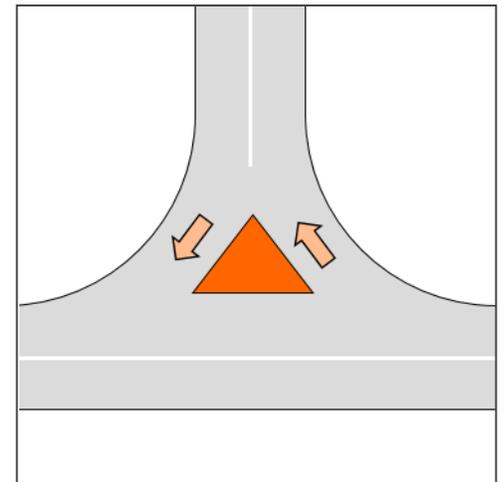


- Vehicle through traffic is reduced.
- Vehicle traffic is prohibited, for specific turning movements.
- Enforcement activities are not required.
- Obstruction may be circumvented by emergency vehicles.

Disadvantages



- Local access points are restricted.
- Raised islands may be circumvented by vehicles if volumes are low.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.



Relative Cost



Moderate

Potential Benefits

Reduced Speed	○
Reduced Volume	●
Reduced Conflicts	◎

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



Arthur St W at Willard Ave

DIVERTER

Access Restriction

A diverter is a barrier that spans diagonally across the center of an intersection. Diverters prevent vehicles from travelling straight through an intersection and may be designed to allow pedestrians and cyclists to travel unrestricted. In some cases, diverters are mountable to allow passage of emergency vehicles. They can be implemented on local and collector roads.

Advantages



- Vehicle through traffic is reduced.
- Vehicle traffic is prohibited, for specific turning movements.
- Enforcement activities are not required.

Disadvantages



- Local access points are restricted.
- Buses and emergency vehicles are obstructed.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.



Relative Cost



Potential Benefits

Reduced Speed	○
Reduced Volume	●
Reduced Conflicts	⊙

○ Negligible ⊙ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



DIRECTIONAL CLOSURE

Access Restriction

A directional closure is a curb extension or barrier that extends from the curb to the centerline of an intersection access and prohibits vehicles from travelling in a specific direction on a roadway. Cyclists are generally allowed to travel through a gap in the obstruction. Directional closures are appropriate where local and collector roads intersect with arterials.

Advantages



- Vehicle through traffic is reduced.
- Vehicle traffic is prohibited, in one direction.
- Reduces pedestrian crossing distance.
- Enforcement activities are not required.
- Obstruction may be circumvented by emergency vehicles.

Disadvantages



- Local access points are restricted.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.



Relative Cost



Moderate

Potential Benefits

Reduced Speed	○
Reduced Volume	●
Reduced Conflicts	◎

○ Negligible ◎ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	✓
Arterials	



FULL CLOSURE

Access Restriction

A full closure uses a barrier to completely restrict motor vehicle access to a roadway. They can be designed to be mountable by emergency vehicles if required. Full closures are only applied to local roads.

Advantages

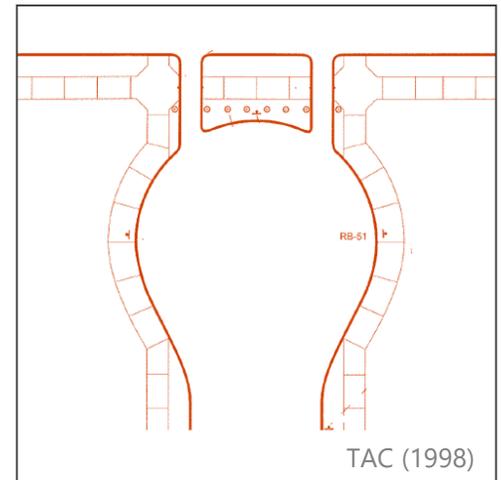


- Vehicle through traffic is prohibited.
- Enforcement activities are not required.
- Obstruction may be circumvented by emergency vehicles.

Disadvantages



- Local access points are restricted.
- Traffic volumes may be displaced to parallel roadways.
- Trip length may be increased for residents.
- Land acquisition may be required, if a turn-around needed.



Relative Cost



High

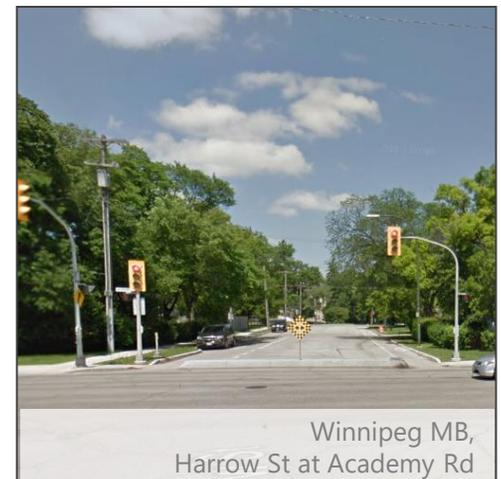
Potential Benefits

Reduced Speed	○
Reduced Volume	●
Reduced Conflicts	●

○ Negligible ◉ Minor ● Substantial

Applicable Road Class

Locals	✓
Collectors	
Arterials	



Winnipeg MB,
Harrow St at Academy Rd

Additional Considerations

While not recognized as traffic calming measures, signage and enforcement can be used to raise awareness of traffic operations issues. This section presents common regulatory signage used alongside traffic calming measures, information signage used to highlight the roadway environment to motorists, and enforcement activities used to emphasize traffic calming measures or temporarily reduce vehicle speeds.

<i>Additional Considerations</i>	<i>pg</i>
SIGNAGE	40
Regulatory Signage	40
Information Signage	41
ENFORCEMENT	42



Signage

This section presents common regulatory signage used alongside traffic calming measures and information signage used to inform motorists of the roadway environment. Signage is not considered a traffic calming measure because it is primarily focused on traffic regulation and requires periodic enforcement to be effective. However, signage plays an important role in ensuring that traffic calming measures reach their full potential and do not compromise safety in any way. It is essential that the proper signage be used consistently in a jurisdiction to support driver expectancy.

Regulatory Signage

Regulatory signage is used to control traffic and has been found to have minimal effect as a traffic calming measure to reduce vehicle speeds and through volumes on its own. Regulatory signage includes posted speed, right-of-way control, turn control, and directional traffic control signs. Guidance on the use of regulatory signage is provided in *Ontario Traffic Manual, Book 5: Regulatory Signs* (MTO, 2000).

Speed & right-of-way control signs.

These signs should only be used for control traffic purposes. Without enforcement, they are ineffective at calming traffic and can reduce motorist compliance of traffic regulations if they are over-used. Common speed and right-of-way control signs include:

Maximum speed



Stop



Yield



Turn & directional traffic control signs.

These signs should only be used to calm traffic when implementation of physical traffic calming measures is not possible. Enforcement may be required and can become costly. Common turn and directional traffic control signs include:

No straight through



No right or left turn



Do not enter



Information Signage

The purpose of information signs is to inform motorists of their driving environment. These signs are not enforceable and therefore their limited ability to reduce vehicle speeds and through volumes is only temporary. Information signage includes traffic-calmed neighbourhood, variable speed display, and school area signs.

Traffic-calmed neighbourhood sign.

These signs are installed to advise motorists that traffic calming measures are installed in the neighbourhood they are about to enter.



(TAC, 2014)

Variable speed display sign.

These signs indicate the spot speed of motorists. They are installed with a maximum speed sign to alert motorists if they are exceeding the legal speed limit.



(City of London)

School area sign.

These signs warn motorists that they are in a school zone and should exercise additional caution due to the presence of children.



(TAC, 2014)

Enforcement

Enforcement activities are not considered traffic calming measures because traffic calming measures are self-enforcing (i.e., they encourage motorist compliance naturally), if implemented properly. The benefit provided by enforcement is often only temporary and usually does not have long lasting effects once enforcement is no longer occurring. However, there may be situations where enforcement activities are necessary to calm neighbourhood traffic. For example, police enforcement can be mobilized in less time than physical traffic calming measures can be constructed. In addition, enforcement may be required if traffic calming measures are not having the desired effect and motorist behavior has not changed. Enforcement is most common on arterial roads. Targeted speed limit enforcement and photo radar are common methods of enforcement.

Targeted speed limit enforcement

Targeted speed limit enforcement requires police department resources to police speeds on roadways with known vehicle speeding issues. This measure only provides a temporary benefit because police resources are not always available. Targeted speed limit enforcement can be applied to all roadway types.

Photo radar

Photo radar is usually installed permanently at intersections on arterial roads or temporarily implemented midblock along local, collector or arterial roads using an unmarked vehicle. This method of enforcement is not as resource intensive as targeted speed limit enforcement. In 2016, the Province of Ontario announced that they are finalizing regulations that will give municipalities authority to install photo radar within their communities.



References and Additional Reading

City of Brampton. (2007). *Neighbourhood Traffic Management Guide*. Brampton, ON.

City of London. (n.d.). *Traffic Calming Policy for Existing Neighbourhoods*. London, ON: City of London.

City of Toronto. (2016). *Traffic Calming Guide for Toronto*. Toronto, ON: Transportation Services Division.

MTO. (2000). *Ontario Traffic Manual, Book 5: Regulatory Signs*. St. Cathernines, ON: Ministry of Transportation, Ontario.

MTO. (2001). *Ontario Traffic Manual, Book 6: Warning Signs*. St. Catherines, ON: Ministray of Transportation, Ontario.

TAC / CITE. (1998). *Candian Guide to Neighbourhood Traffic Calming*. Ottawa, ON: Transportation Association of Canada / Canadian Institute of Transportation Engineers.

TAC. (2014). *Manual of Uniform Traffic Control Devices for Canada*. Ottawa, ON: Transportation Association of Canada.

Urban Systems Ltd. (2010). *The City of Calgary Traffic Calming Policy*. Calgary, AB: City of Calgary.

Photo Credits

All photos have been acquired from Google Street View.

