

SEATTLE SAFE ROUTES TO SCHOOL ENGINEERING TOOLKIT





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This toolkit describes the engineering strategies the Seattle Department of Transportation commonly uses to make streets safer and more comfortable for kids walking and biking to school.

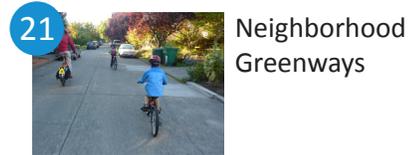
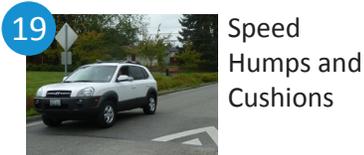
CROSSING TREATMENTS



ALONG THE STREET TREATMENTS



TRAFFIC CALMING



OTHER

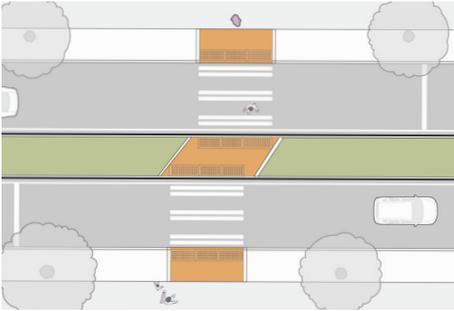


CROSSING ISLANDS

Crossing islands (also called pedestrian refuges or center islands) are raised areas in the middle of the street at intersections or mid-block crossings that protect people walking and biking from people driving while they wait for an opportunity to cross the other half of the street.



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Typical crossing island.



Landscaping beautifies the crossing island.



Crossing islands also help people on bicycles to cross the street.

WHAT IS THE PURPOSE OF A CROSSING ISLAND?

1. Makes the crossing more visible to people driving
2. Allows the person crossing to deal with one direction of car traffic at a time, making it quicker and easier to find a gap in traffic
3. Reduces the amount of time a person crossing the street is exposed to traffic, since they have a place in the middle of the crossing
4. Makes the street easier to cross for kids, older adults, people with disabilities, and others who may need more time to cross or have more difficulty judging gaps in traffic
5. Slows down people driving as they approach the crossing, since the crossing island makes the space for cars in the street visually narrower at the crossing

REFERENCES AND RESOURCES

Seattle Right-of-Way Improvement Manual
Neighborhood Park and Street Fund
Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE): Crossing Islands
NACTO Urban Bikeway Design Guide: Median Refuge Island
FHWA Proven Safety Countermeasures: Medians and Pedestrian Crossing Islands

EXAMPLES IN SEATTLE

Beacon Ave S at S Hanford St
E Olive Way and Boylston Ave E
Boren Ave at Spring St



HOW DOES SDOT DECIDE WHERE TO INSTALL A CROSSING ISLAND?

1. We use data to understand the number and speed of people driving on the street. We also look at the number of traffic lanes a person has to cross.
2. There has to be space in the middle of the road to install the crossing island. Generally, streets with a two-way center turn lane and a small number of left turns by people driving allow for installing a crossing island.
3. We also consider putting in other safety improvements like crossing beacons along with the crossing island to make the crossing even more visible to people driving
4. At crossings used by a lot of people on bikes, for example at neighborhood greenway crossings, we consider putting in a separate curb cut in the crossing island to separate people biking and people walking

HOW MUCH DOES A CROSSING ISLAND COST?

\$\$: A small asphalt or concrete crossing island can be fairly inexpensive. Larger projects that also include landscaping can increase construction costs and maintenance.

HOW LONG DOES IT TAKE TO INSTALL A CROSSING ISLAND?

1-2 years: A simple project can be designed in six months and constructed easily by City crews. A larger crossing island or crossing islands at busy intersections need more time to design. We use contractors for these types of projects instead of City crews, which adds more time.

CURB BULBS

Curb bulbs (also called curb extensions) are created by extending the curb line into the roadway at a corner or mid-block. They shorten the distance for people walking across the street and improve visibility between people walking and driving. By visually and physically narrowing the roadway, curb bulbs also help slow down people driving.



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Mid-block curb bulb.



Easy-to-install materials such as paint and flex posts may be used to create curb bulbs.



Curb bulbs may provide space for landscaping.

WHAT IS THE PURPOSE OF A CURB BULB?

1. Improves safety by shortening the distance to cross the street and reducing the amount of time people are walking in the street
2. Improves visibility between people driving and people walking across the street
3. Provides additional space in constrained locations for installing curb ramps
4. Slows down cars making a right turn by making the angle of the corner sharper
5. Prevents people from parking too close to a crosswalk or from blocking a curb ramp or crosswalk
6. Provides space for seating, public art, bike racks, rain gardens or other public amenities

HOW DOES SDOT DECIDE WHERE TO INSTALL A CURB BULB?

1. We consider installing curb bulbs at locations that would benefit from improved visibility between people walking and driving, such as at school crosswalks
2. Curb bulbs can be installed:

- a. at most locations with a legal crosswalk, whether marked or unmarked
- b. on streets with all day on-street parking
- c. at locations where they do not extend into travel lanes or bike lanes. Before considering installing a curb bulb, we check the Bicycle Master Plan to make sure that a new curb bulb would not prevent installation of a bike lane in the future.

HOW MUCH DOES A CURB BULB COST?

\$\$\$: Curb bulbs typically involve roadway and sidewalk removal and replacement and relocation of stormwater drainage inlets. Cost can sometimes be reduced when installed as part of larger capital projects such as street repaving.

HOW LONG DOES IT TAKE TO INSTALL A CURB BULB?

1-2 years: Typically design is completed in 6-12 months and construction is completed by a contractor the following year.

REFERENCES AND RESOURCES

Seattle Right-of-Way Improvements Manual
Pedestrian Safety Guide and Countermeasure Selection System: Curb Extensions
NACTO Urban Street Design Guide: Curb Extensions
AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities, 2015
SDOT: Curb Bulbs

EXAMPLES IN SEATTLE

12th Avenue E and E Thomas Street
E Union Street and 32nd Avenue
S Graham Street and 42nd Avenue S



CURB RAMPS

Curb ramps are sloped areas located at intersection corners and crossings that connect the street to the sidewalk. They create a barrier-free environment for everyone when crossing streets that have curbs and sidewalks.



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Curbs limit universal accessibility and are barriers for transitioning from the sidewalk to the street.



A sidewalk retrofitted with a curb ramp and a tactile warning strip.



Each corner should have two curb ramps, one for each crossing.

WHAT IS THE PURPOSE OF A CURB RAMP?

Provides a comfortable transition from the street to the sidewalk for all people, including people with disabilities, kids on bikes, and caretakers pushing strollers

HOW DOES SDOT DECIDE WHERE TO INSTALL A NEW CURB RAMP?

1. We install curb ramps on all major construction projects such as when the street is repaved or reconstructed
2. We use the Pedestrian Master Plan to select and prioritize new curb ramp locations and we also prioritize locations closest to schools
3. People with disabilities and their caregivers can request curb ramps at locations where curbs are barriers to accessing things like bus stops and community centers

HOW MUCH DOES A NEW CURB RAMP COST?

\$\$: The federal Americans with Disabilities Act (ADA) lays out very specific requirements for how curb ramps must be constructed, including level landings and gentle grades. Adjacent sidewalks often have to be reconstructed to meet those design requirements.

HOW LONG DOES IT TAKE TO INSTALL A CURB RAMP?

1-2 Years: Design is completed in 6-12 months with construction by a contractor the following year.

ADDITIONAL INFORMATION

We have a curb ramp program that routinely installs or upgrades curb ramps throughout the city and also installs curb ramps where needed by people with disabilities on a request basis.

REFERENCES AND RESOURCES

Seattle Department of Transportation: Curb Ramps
Seattle Right-of-Way Improvements Manual
Safe Routes to School Online Guide



MARKED CROSSWALKS

Crosswalks are at every intersection, whether marked or unmarked. We use marked crosswalks to raise driver awareness of people crossing the street and to direct people who are walking to the best place to cross the street.



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Marked crosswalk at an intersection.



Raised crosswalks approaching crosswalks slow people down.



Advanced stop bars increase visibility of people crossing the street.

RAISED CROSSWALKS

Benefits:

- Raised crosswalks keep the crosswalk level with the sidewalk
- They act as a speed hump and slow down people driving as they approach the crosswalk
- They also make people walking more visible to people driving

Design Considerations:

- Raised crosswalks may require modifications to storm water drainage in the street, increasing the cost
- SDOT ensures that emergency vehicles and buses aren't impacted by a raised crosswalk

Examples in Seattle

- California Ave between SW Alaska St and SW Edmonds St,
- Martin Luther King Jr. Way at Alder St
- 14th Ave S at Beacon Ave S

RAISED INTERSECTIONS

- Raised intersections slow down people driving and encourage them to yield for people walking across the street
- Raised intersections can be installed in important neighborhood intersections to make the public space more comfortable and inviting for people to walk and bike

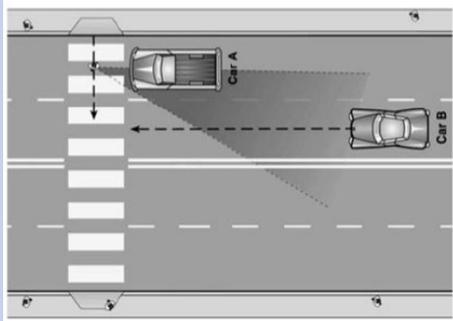
WHAT IS THE PURPOSE OF A MARKED SCHOOL CROSSWALK?

1. Direct school kids who are walking to the best place to cross the street
2. Indicate the walking route to school
3. People driving are made more aware of where to expect school kids to cross the street

HOW DOES SDOT DECIDE WHERE TO MARK A CROSSWALK?

1. SDOT usually only marks crosswalks across main arterial streets. One exception is that we may mark school crosswalks on residential streets if they are within 300 feet of a school
2. First, SDOT counts the number of people crossing the street. If we see 10 kids or 20 people crossing in an hour, then we can move to the next step.
3. Next, we check to see if there are curb ramps on either side of the proposed marked crosswalk. The Federal Americans with Disabilities Act (ADA) requires that any street crossing that has a marked crosswalk provides a way, like a curb ramp, for a person in a wheelchair to get out of the street. The ADA lays out very specific requirements for how curb ramps must be constructed. Curb ramps are also helpful for kids riding bicycles on the sidewalk and caretakers pushing strollers.

MARKED CROSSWALKS



MULTIPLE THREAT

A multiple threat is a situation where a driver in one lane (car A) stops for a person crossing the street, but the driver in the next lane (car B) doesn't see the person and doesn't stop. If we mark a crosswalk across more than two lanes of traffic, we consider installing additional safety improvements like crossing beacons, pedestrian signals, crossing islands, curb bulbs, or advanced stop lines to remove the multiple threat.

4. Other things we look at include:
 - a. How far away the closest existing marked crosswalk is to the proposed new marked crosswalk. We typically don't mark a new crosswalk if it is within 200 feet of an existing marked crosswalk.
 - b. Visibility of the crosswalk by people driving. We make sure people driving can see the crosswalk soon enough to stop for a person crossing the street.
 - c. Location of street lighting to make sure the proposed marked crosswalk location is well lit at night.
 - d. Number of traffic lanes a person walking would have to cross. If there is more than one lane of traffic in each direction, then we will consider doing something more than just mark the crosswalk because of the potential multiple threat. This could include things like crossing beacons, pedestrian signals, crossing islands, curb bulbs, or advanced stop lines.
 - e. Number and speed of people driving. If the street is really busy with people driving fast, then we consider doing something more than just mark the crosswalk.
 5. If we do mark a new crosswalk, we also put up crosswalk signs. If it's a crosswalk mostly used by kids, then we make it a school crosswalk with school crosswalk signs. Otherwise, we use regular crosswalk signs.
 6. We use a very durable, reflective material to mark crosswalks, but after a while they may need to be re-marked. We prioritize crosswalk maintenance based on the condition of all the crosswalks in the city. We usually re-mark about 150 school crosswalks per year. If you're concerned about the condition of a crosswalk, we can tell you if it's on our maintenance list for the coming year.
- HOW LONG DOES IT TAKE TO INSTALL A MARKED CROSSWALK?**
- <1 year: If the location has curb ramps that meet ADA requirements, it can take less than one year to install a new marked crosswalk.
- 1-2 years: If we need to install new curb ramps or other safety improvements in addition to the marked crosswalk, then it takes longer to get the work done.
- HOW MUCH DOES A NEW MARKED CROSSWALK COST?**
- ⌘: If a potential new marked crosswalk location already has curb ramps that meet ADA requirements and only crosses two lanes of traffic, then marking the crosswalk is relatively inexpensive and straight forward.
- ⌘⌘: If we need to install new curb ramps or other safety improvements.

REFERENCES AND RESOURCES

Pedestrian Safety Guide and Countermeasure Selection System: Marked Crosswalks and Enhancements
Pedestrian Safety Guide and Countermeasure Selection System: Raised Pedestrian Crossings
SDOT webpage on marked crosswalks

CROSSING BEACONS

Crossing beacons (also called Rectangular Rapid Flash Beacons or RRFBs) are pedestrian-activated flashing lights on the side of the street that make a crosswalk more visible to people driving and alert them to the presence of a person trying to cross the street.



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Crossing beacon with passive detection.



Crossing beacon with push button at a school crosswalk.



Crossing beacon at neighborhood greenway arterial crossing.

WHAT IS THE PURPOSE OF A CROSSING BEACON?

1. Makes the presence of a person trying to cross the street known to people driving, since they only flash when someone pushes the button to activate the light
2. Studies have shown that people driving are a lot more likely to stop for people trying to cross the street when they activate a rectangular rapid flash beacon. The highly visible stutter flash of RRFBs is very eye-catching to people driving.

WHEN DOES SDOT INSTALL A CROSSING BEACON?

1. We use data to understand the number and speed of people driving on the street as well as the number of traffic lanes a person has to cross
2. Crossing beacons can be installed at crosswalks that have other safety improvements, like a crossing island

HOW MUCH DOES A CROSSING BEACON COST?

\$\$: Crossing beacons are a relatively inexpensive way to improve safety for people crossing the street. The cost to install crossing beacons can increase if the crossing doesn't already have a marked crosswalk with curb ramps that meet Federal Americans with Disabilities Act requirements.

HOW LONG DOES IT TAKE TO INSTALL A CROSSING BEACON?

1-2 years: As long as the crossing already has a marked crosswalk with curb ramps that meet Federal Americans with Disabilities Act requirements, installing a crossing beacon is a relatively quick improvement.



REFERENCES AND RESOURCES

Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE): RRFB
FHWA Intersection Safety Technologies

EXAMPLES IN SEATTLE

Boston St at 4th Ave N
24th Ave NW at NW 58th St.
Dexter Ave N at Howe St.

20 MPH ZONES

20 MPH Zones are areas within neighborhoods where the speed limit is lowered from 25 MPH to 20 MPH. This program is part of Vision Zero, the City's plan to end traffic deaths and serious injuries by 2030.



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Signage, pavement, markings, and other engineering treatments are used to establish 20 mph zones

WHAT IS THE PURPOSE OF A 20 MPH ZONE?

Slows down people driving and helps reduce collisions to make neighborhood streets safer and more comfortable for people walking, biking, and driving

HOW DOES SDOT DECIDE WHERE TO INSTALL 20 MPH ZONES?

1. We started a pilot project with eight 20 MPH zones in 2015
2. We used data to help us understand which neighborhood streets have the highest speeds and have had the most collisions in recent years. We also looked at neighborhood streets that are used a lot by people walking.
3. The pilot project will help us understand how we can most effectively implement 20 MPH zones

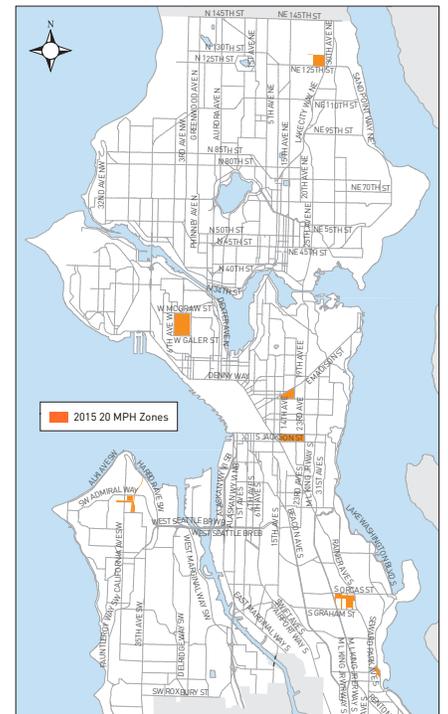
HOW MUCH DOES A 20 MPH ZONE COST?

\$: Each 20 MPH Zone will start with a first phase, where SDOT will install 20 MPH signs and 20 MPH markings on the street.

\$\$: If people driving on these streets aren't slowing down to the new speed limit, we will roll out a second phase that could include installing devices like speed humps.

HOW LONG DOES IT TAKE TO INSTALL 20 MPH ZONES?

>1 year: SDOT has identified priority locations for 20 MPH Zones in 2015.



REFERENCES AND RESOURCES

SDOT Neighborhood Traffic Operations <http://www.seattle.gov/transportation/20MPHzones.htm> provides information on 20 MPH Zones.



TRAFFIC SIGNALS

Traffic signals coordinate the flow of traffic at intersections, including people driving, people walking, and people biking.



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Bicycle signal detection.



Reflective back plate makes the signal more visible.



"No Turn on Red" sign.

WHAT IS THE PURPOSE OF A TRAFFIC SIGNAL?

1. Controls the flow of traffic and provides coordinated movement of people driving, walking, and biking.
2. Provides a safer, more comfortable place to cross a busy street for people walking and biking. People driving have to completely stop at red lights when it's the pedestrian's or cyclist's turn to cross the street.
3. When there's a steady stream of traffic, it would be difficult for people walking or biking to find a gap in traffic to cross the street. The traffic signal reduces the amount of time it would take to cross a busy street by providing that gap in traffic.

HOW DOES SDOT DECIDE WHERE TO INSTALL A TRAFFIC SIGNAL?

1. We use the national Manual on Uniform Traffic Control Devices (MUTCD) to determine if the safety of an intersection would be improved by installing a new traffic signal. The MUTCD outlines certain minimum thresholds of vehicle and pedestrian traffic and collisions that have to be met before we can consider installing a traffic signal.
2. If a location meets the MUTCD thresholds, then we do an engineering study to further analyze traffic patterns and determine whether a new signal would improve safety or the flow of traffic.
3. For new or existing traffic signals, we consider how to make the intersection safer and convenient for people walking and biking:
 - a. Giving people driving a chance to make a left turn without people walking across the street makes it safer for people walking. This is called a protected left-turn.
 - b. At some intersections, for example some places downtown, people driving aren't allowed to make a right turn when the traffic signal is red. That makes it safer for people walking across the street.
 - c. Traffic signals are most convenient for people walking when the WALK sign is displayed automatically when it's their turn to cross the street. That's not always possible, so some traffic signals have push buttons for people to activate the WALK sign.
 - d. At intersections that are used by a lot of people on bikes, for example at neighborhood greenway crossings of busy streets, push buttons can be installed to make it easier for people on bikes to cross the street. SDOT can also install detection in the pavement that automatically senses when bikes are present. These are marked with a "T" or with a bicycle symbol to indicate optimal positioning for signal detection.

TRAFFIC SIGNALS



LEADING PEDESTRIAN COUNTDOWNS AND PEDESTRIAN INTERVAL (LPI)

A pedestrian countdown signal shows the number of seconds left before the WALK phase is over. This helps people walking know how much time they have left to cross the street and can help reduce the number of people in the crosswalk near the end of the WALK phase. It's safest for people walking to be out of the crosswalk when the signal turns green for people driving in the opposite direction.

LPIs give people walking the WALK sign 3-5 seconds before people driving get a green signal. Because people walking are already in the crosswalk when people driving try to turn left or right, people driving are more likely to yield to people walking.



Leading pedestrian interval-vehicles have red signal for the first 3-5 seconds of the WALK phase.

HOW MUCH DOES A TRAFFIC SIGNAL COST?

\$\$\$\$: Installing a new traffic signal is a very costly safety improvement. When possible, we try to find less costly safety improvements that achieve the same safety objectives so that we can do as much work as possible with our limited City resources.

HOW LONG DOES IT TAKE TO INSTALL A TRAFFIC SIGNAL?

2-4 years: We only construct 2-3 new signals per year because they are so costly. They take a long time to design and construct because they are complex systems.

4+ years: If the new signal is on a State Route, including Highway 99 and Lake City Way NE, then we coordinate with the Washington State Department of Transportation, which adds time to the process.

REFERENCES AND RESOURCES

Manual on Uniform Traffic Control Devices, Section 4C

Seattle Right of Way Improvement Manual

Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE): Traffic Signals

Federal Highway Administration Proven Safety Countermeasures



STOP SIGNS

Stop signs are a traffic control device used at intersections with three or more approaches where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law.



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Stop sign with stop line at an all-way stop.



Stop sign oriented to traffic crossing a neighborhood greenway.



Stop sign at intersection between a neighborhood street and a busier street.

WHAT IS THE PURPOSE OF A STOP SIGN?

1. Controls traffic of people driving, walking, and biking by assigning the right-of-way at an intersection
2. May be used to control one direction of traffic while letting the other direction flow freely or can be used to control all directions of traffic

HOW DOES SDOT DECIDE WHERE TO INSTALL A STOP SIGN?

1. We use the national Manual on Uniform Traffic Control Devices (MUTCD) to determine if the safety of an intersection would be improved by controlling one or more direction of traffic with a stop sign. The MUTCD outlines certain minimum thresholds of car, pedestrian, and bicyclist traffic and collisions that have to be met before we can consider installing a stop sign.

2. If the numbers of people driving, walking, and biking from each direction of the intersection is approximately equal and meets the minimum thresholds, we will consider installing stop signs for all directions of travel
3. If the numbers of people driving, walking, and biking from each direction are unequal, the street with the lower volume of people traveling should be stop controlled unless there are reasons to provide an advantage to one direction of travel (e.g. Neighborhood Greenway)
4. Other things we consider include:
 - a. direction of school walking routes
 - b. visibility and sight distance by the different sides of the intersection
 - c. providing advantage to one direction of travel over another, e.g. Neighborhood Greenway or major trail connection (e.g. the Burke Gilman Trail)
5. Stop signs may be accompanied by stop lines, which indicate to people driving where to stop their car before the intersection

REFERENCES AND RESOURCES

Manual for Uniform Traffic Control Devices
AASHTO Guide for the Development of Bicycle Facilities

HOW MUCH DOES A STOP SIGN COST?

\$. Stop signs are a relatively low cost and effective way of controlling traffic at intersections

HOW LONG DOES IT TAKE TO INSTALL A STOP SIGN?

>1 year: If we determine that an intersection should have one or more new stop signs, they can be installed relatively quickly



SIDEWALKS

Sidewalks are the building blocks of the pedestrian network. There are currently more than 2,000 miles of sidewalks in Seattle, yet many areas in the city do not have sidewalks at all. Sidewalks provide the greatest benefit to people when they are wide enough for two people to walk side-by-side, maintained in good condition with few bumps or cracks, kept clear of snow and overgrowing plants, and built with curbs.



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Severe cracking creates uneven and hazardous walking surfaces.



New sidewalk remains level across driveway.



Alternative sidewalk design.

BENEFITS AND APPLICABILITY

1. Improves safety and comfort of people walking by separating pedestrians from people moving faster on bikes or in cars
2. Provides a dedicated space away from car traffic for children to walk, play, and learn to ride a bike

HOW DOES SDOT DECIDE WHERE TO BUILD A NEW SIDEWALK?

1. We use prioritization criteria from the Pedestrian Master Plan which includes considerations of:
 - a. Where people need and want to walk, not only today but in the future
 - b. Equity factors, like car ownership rates and where people with low-income or disabilities live
 - c. Street types, whether busy main streets or quiet neighborhood streets
 - d. Street factors, like the number and speeds of people driving, whether there's parking, if the side of the road has a curb, and more

2. We prioritize locations close to schools that are missing sidewalks over locations further away from schools
3. Developers often have to build new sidewalks as a requirement for development permits

HOW MUCH DOES A NEW SIDEWALK COST?

\$\$\$\$ - Building new sidewalks is an expensive and challenging engineering project. Nearby property owners often have to be coordinated with, driveways connecting to private property rebuilt, encroachments of private property onto public property removed, and new stormwater infrastructure constructed.

HOW LONG DOES IT TAKE TO GET A NEW SIDEWALK INSTALLED?

4+ Years: Design and outreach are conducted in the first two years, design is completed in the third year, and construction of the sidewalk happens in the fourth year. Grants may need to be written to help cover the cost of construction which may add to the timeline.

ADDITIONAL INFORMATION

When conventional sidewalks are not feasible to build, other strategies may be considered for creating safer walking routes to school, such as Neighborhood Greenways (See Neighborhood Greenways Information Sheet), reallocating road space to create a dedicated walking space, and alternative surfacing materials.

Property owners are responsible for keeping sidewalks next to their property in good condition. This includes removing overgrown plants, clearing snow and ice, and making repairs to the sidewalk surface. Please see SDOT Client Assistance Memo (CAM) 2208 for more information.

REFERENCES AND RESOURCES

- Pedestrian Master Plan Walking Preferences Survey
- CDC - Youth Physical Activity Guidelines
- City of Seattle Pedestrian Masterplan



BIKEWAYS

Bikeways are routes, paths or road design features made for people on bikes. They are divided into two categories: on-street and off-street. On-street bikeways include bike lanes, buffered bike lanes, protected bike lanes and intersection treatments such as green pavement markings. Off-street bikeways include trails and side paths.



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Protected two-way bike lane



Cross bike markings



Bike box

WHAT IS THE PURPOSE OF A BIKEWAY?

1. Encourages more people to feel comfortable to ride a bike anywhere, including to school
2. Provides safety and predictability by separating people biking from people driving
3. Makes biking a real transportation option with many benefits like avoiding traffic congestion, reducing parking costs, decreasing the time spent commuting, and helping reduce emissions that contribute to climate change
4. Increases the reliability of the road network that allows people to go anywhere they want on a bike

HOW DOES SDOT DECIDE WHERE TO INSTALL A BIKEWAY?

1. The Seattle Bicycle Master Plan prioritizes the location and order in which bikeways are built every year. Current funding levels, traffic and safety data, and leveraging opportunities are also considered to decide when and where these facilities are built.

REFERENCES AND RESOURCES

Seattle Right-of-Way Improvements Manual
Seattle Bicycle Master Plan
NACTO Urban Bikeway Design Guide
AASHTO Guide for the Development of Bicycle Facilities, 2012
BIKESAFE Bicycle Countermeasure Selection System

2. We use data to understand where and what type of bikeway to install, including:
 - a. Current roadway space to make sure there's enough space to accommodate the right type of bike facility for the street.
 - b. Current and future traffic volumes as well as speed limits.
3. Bikeways that are more separated from car traffic, like off-street multi-use paths and protected bike lanes, are more appropriate and comfortable for kids biking to school.

HOW MUCH DOES A BIKEWAY COST?

\$\$-\$\$\$\$: The cost of a bikeway depends on the type. Simpler projects, like shared streets, cost much less than an off-street multi-use trail or protected bike lane.

HOW LONG DOES IT TAKE TO INSTALL A BIKEWAY?

>1 year: Installing a bikeway depends significantly on the length of the route and scope of the project. However it will typically range from eight months, which may include the planning, design and construction phases, up to one year after installation to collect data and perform a before-and-after evaluation.



RADAR SPEED SIGNS

Radar speed signs (also known as speed feedback signs) use radar to detect and display the speed of people driving past. These signs help slow down people driving by reminding them of what their speed is compared to the posted speed limit.



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Speed feedback sign displays a driver's speed compared to the speed limit.



Solar powered speed radar sign.



Speed feedback may also flash a "slow down" message.

WHAT IS THE PURPOSE OF A RADAR SPEED SIGN?

Raises awareness of the speed a person is driving and encourages them to slow down if they are driving above the speed limit

HOW LONG DOES IT TAKE TO INSTALL A RADAR SPEED SIGN?

1-2 years: Priority streets are usually identified one year and construction happens the next year.

HOW DOES SDOT DECIDE WHERE TO INSTALL A RADAR SPEED SIGN?

1. We use data to understand the number and speed of people driving on the street
2. We consider installing radar speed signs on busier streets where most people are driving 5 MPH or more over the speed limit

SPEED TRAILER

We also have mobile trailers with radar speed signs that are temporarily posted at about 50 locations every year. We prioritize locations based on measured speeds on the street. 20 MPH school zones are a high priority for deploying the speed trailers.

HOW MUCH DOES A RADAR SPEED SIGN COST?

\$\$: We usually install two radar signs on a street: one radar sign for each direction of traffic. Most radar speed signs have been installed by the Neighborhood Traffic Calming program.

REFERENCES AND RESOURCES

SDOT Neighborhood Traffic Operations provides information on the arterial traffic calming program.

EXAMPLES IN SEATTLE

The Arterial Traffic Calming Map at http://www.seattle.gov/transportation/ntcp_arterial.htm shows where there are radar speed signs.



LANE REDUCTION: DESIGNING SAFER STREETS

On busier, multi-lane streets, a lane reduction can improve safety for all roadway users. Depending on the needs of the street, which are determined by careful analysis, general purpose, parking or turn lanes may be repurposed for other uses such as wider sidewalks, street trees, bike lanes, or more efficient transit.



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NE 130th Street before lane reduction



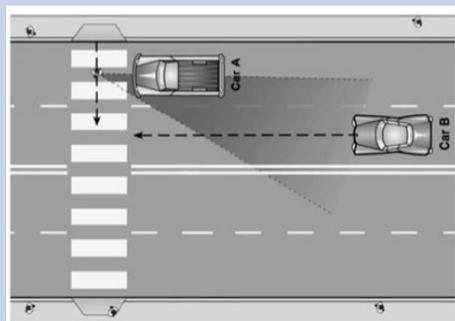
NE 130th Street after lane reduction.



NE 125th Street after lane reduction

WHAT IS THE PURPOSE OF A LANE REDUCTION?

1. Makes it easier and safer for people to cross busy streets by reducing at unsignalized intersections the number of traffic lanes a person has to cross. When people cross streets with more than one lane in each direction they encounter a 'multiple threat.'
2. Frees up space on the street to widen sidewalks, plant street trees, add curb bulbs, or install protected bike lanes.
3. Slows down people driving, which makes the street safer for everyone. When there's one lane in each direction, a person driving can only go as fast as the person in front of them.
4. Makes it safer for people driving to make a left turn when a center turn lane is added, and a single lane of traffic helps manage drivers cutting in and out of lanes, which helps reduce collisions .
5. Narrowing the width of travel lanes can also slow down people driving and free up space on the street to make it safer and more comfortable for people walking and biking



MULTIPLE THREAT

A multiple threat is a situation where a driver in one lane (car A) stops for a person crossing the street, but the driver in the next lane (car B) doesn't see the person and doesn't stop. If we mark a crosswalk across more than two lanes of traffic, we consider installing additional safety improvements like crossing beacons, pedestrian signals, crossing islands, curb bulbs, or advanced stop lines to remove the multiple threat.

LANE REDUCTION



A three-lane to two-lane reduction.



Lane reduction on NE 75th St.



Center turn lane narrowed to provide space for bike lanes.

HOW DOES SDOT DECIDE WHERE TO DO A LANE REDUCTION?

1. Whenever streets are being resurfaced or reconstructed there is an opportunity to change the configuration of lanes on the street
2. Streets that are good candidates to have one lane in each direction with a center turn lane have:
 - a. fewer than 25,000 vehicles per day
 - b. a large number of driveways or driveways with frequent use
 - c. a lot of rear end collisions or collisions between people driving and people walking across or along the street
3. On some streets, people aren't allowed to park during the busiest times of day in order to free up another travel lane for cars. A simple way to reduce the number of traffic lanes on the street is to allow parking all day.
4. We take a look at the flow of traffic to make sure a lane reduction wouldn't cause back-ups at traffic signals

HOW MUCH DOES A LANE REDUCTION COST?

\$\$\$: The cost of a lane reduction is highly variable; it involves grinding the lane lines off the street and repainting new lane lines, often at night or on weekends to minimize traffic disruptions. A lane reduction is usually done as part of a larger project to resurface or reconstruct a street.

HOW LONG DOES IT TAKE TO DO A LANE REDUCTION?

1-2 years: We generally host one or two open houses to gather community input and influence design decision in the first year; construction typically follows the year after.

REFERENCES AND RESOURCES

Pedestrian Safety Guide and Countermeasure Selection System: Lane Reduction (Road Diet)
FHWA Proven Safety Countermeasures: Road Diet (Roadway Reconfiguration)

EXAMPLES IN SEATTLE

N 130th St (lane reduction)
S Columbian Way (lane reduction)
50th Avenue S (lane narrowing)

SPEED HUMPS AND CUSHIONS

Speed humps, speed cushions, and speed tables are devices that encourage people driving to slow down. Speed humps are raised areas that extend across the street. Speed cushions are similar to speed humps except that they have wheel cutouts to allow large vehicles, like buses or emergency vehicles, to pass through unaffected. Speed tables are flat-topped speed humps that are long enough to raise the whole wheelbase of a car.



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Speed hump.



Speed cushions allow for larger vehicles such as fire trucks to pass through unimpeded.



Speed humps installed on hills may include a cut for downhill bicyclists.

WHAT IS THE PURPOSE OF SPEED HUMPS, SPEED CUSHIONS, AND SPEED TABLES?

1. Slow down people driving to make streets safer and more comfortable for people walking and biking
2. Speed humps are usually installed on neighborhood streets, whereas speed cushions and speed tables are usually installed on busier streets used by large vehicles, like buses or emergency vehicles

HOW DOES SDOT DECIDE WHERE TO INSTALL SPEED HUMPS, SPEED CUSHIONS, AND SPEED TABLES?

1. We use data to understand the number and speed of people driving on the street
2. If the speed that most people drive on the street is 5 MPH or more over the speed limit, then we consider installing speed humps on neighborhood streets or speed cushions on busy streets
3. We install speed humps and speed cushions about every 400 feet along the street
4. It's our policy to always install speed humps on neighborhood greenway routes

RAISED CROSSWALKS

- Raised crosswalks keep the crosswalk level with the sidewalk
- They act as a speed hump and slow down people driving as they approach the crosswalk
- They also make people walking more visible to people driving

5. If a street is too steep then we can't install speed humps because of the stormwater drainage system
6. When making a crosswalk safer is also an important factor, we consider installing speed tables at crosswalks to raise the crosswalk and improve visibility

HOW MUCH DOES A SPEED HUMP, SPEED CUSHION, OR SPEED TABLE COST?

\$: Speed humps and cushions are a low-cost way to slow down people driving.

\$\$: Raised crosswalks or speed tables cost two to four times more than speed humps.

HOW LONG DOES IT TAKE TO INSTALL A SPEED HUMP?

1-2 years: Priority streets with high speeds are usually identified one year and construction happens the next year.

REFERENCES AND RESOURCES

SDOT Neighborhood Traffic Operations: Traffic Calming Program

EXAMPLES IN SEATTLE

Speed humps are installed on neighborhood streets throughout Seattle.

Speed cushion: 3rd Ave NW between NW 105th St and NW 107th St

Raised crosswalk: 14th Ave S at Beacon Ave S



TRAFFIC CIRCLES

Traffic circles guide car traffic through an intersection in one direction around a central island. They are usually installed at intersections of neighborhood streets. Traffic circles are very effective at slowing down people driving and reducing collisions. When installed in a series along a street corridor, they are even more effective at keeping car speeds down all along the street.



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The horizontal deflection of chicanes and traffic circles force drivers to slow down.



Traffic circles create more comfortable conditions for people walking and biking.



Traffic circle at school crossing.

WHAT IS THE PURPOSE OF A TRAFFIC CIRCLE?

1. Slows down people driving and reduces collisions to make neighborhood streets safer and more comfortable for people walking, biking, and driving
2. Provides an opportunity to beautify a neighborhood street by adding trees, plants, and flowers

HOW DOES SDOT DECIDE WHERE TO INSTALL A TRAFFIC CIRCLE?

1. We use data to understand the number and speeds of people driving on a street and how many collisions have happened at that location in recent years
2. We consider installing a traffic circle at intersections that have had five or more collisions in the past three years
3. Before we design and construct a traffic circle, we identify neighbors who will volunteer to maintain the plants in the traffic circle

HOW MUCH DOES A TRAFFIC CIRCLE COST?

\$\$: Most traffic circles have been installed by the Traffic Circle Program.

HOW LONG DOES IT TAKE TO INSTALL A TRAFFIC CIRCLE?

1-2 years: Priority intersections are usually identified one year and construction happens the next year.



REFERENCES AND RESOURCES

SDOT Neighborhood Traffic Operations <http://www.seattle.gov/transportation/trafficcircles.htm> provides information on the traffic circle program.

EXAMPLES IN SEATTLE

Many neighborhood streets around the city have traffic circles.

NEIGHBORHOOD GREENWAYS

Neighborhood greenways are residential streets with low numbers of people driving and slow speeds that have been re-designed to be safer and calmer, encouraging people of all ages and abilities to walk and bike.



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Residential streets are great for Greenways.



NW 58th St. Greenway in Ballard.



Intersection design is an important consideration at arterial street crossings.

WHAT IS THE PURPOSE OF A NEIGHBORHOOD GREENWAY?

1. Encourages more people to walk and bike by keeping car volumes and speeds low and helping them to cross busy streets
2. Provides safer more comfortable routes to school for kids on foot or on bike
3. Provides better connections for kids on foot or on bike to other places in their neighborhood, like parks, libraries, and community centers

HOW DOES SDOT DECIDE WHERE TO INSTALL A NEIGHBORHOOD GREENWAY?

1. The Seattle Bicycle Master Plan prioritizes the general location and order in which greenways are built every year. Current funding levels, traffic and safety data, and leveraging opportunities are also considered to decide when and where greenways are built.
2. Some elements we consider when selecting a specific route include:
 - a. Residential streets that connect people to neighborhood destinations such as schools, parks, shops and restaurants, among others
 - b. Streets with low numbers of people driving and slow speeds. An ideal street for a neighborhood greenway has fewer than 1,500 cars per day and speeds close to 20 MPH.
 - c. Relatively flat streets that are comfortable for people to walk or bike

- d. How to make the most of existing infrastructure to help people cross busy streets, such as traffic signals at busy intersections
- e. New safety improvements at intersections of busy streets, such as crossing islands and crossing beacons
3. Typical elements of a neighborhood greenway include:
 - a. Speed limit of 20 MPH
 - b. Speed humps
 - c. Signs and pavement markings to help people find their way
 - d. Some combination of curb extensions, crossing beacons, crosswalks, crossing islands, or traffic signals at busy intersections
 - e. Stop signs at streets crossing the greenway
 - f. Smooth sidewalks and streets
 - g. Curb ramps



NEIGHBORHOOD GREENWAYS



Crossing islands help Neighborhood Greenway users cross busier streets.

HOW MUCH DOES A NEIGHBORHOOD GREENWAYS COST?

\$\$\$\$: The cost to build a new neighborhood greenway can vary based on how much work needs to be done to make crossings of busy streets safer.



Signage and pavement markings help navigate greenway users to destinations.

HOW LONG DOES IT TAKE TO INSTALL A NEIGHBORHOOD GREENWAY?

1-2 years: Once a new neighborhood greenway project has been funded, it can take one to two years to install the greenway. During the early phases of a greenway project, we collect and analyze traffic data to understand existing conditions. We gather public feedback through community outreach, which helps us select the most promising route for the greenway. Once a route is chosen, the design phase and some pre-construction work may occur. Every greenway design is unique depending on neighborhood characteristics.



EXAMPLES IN SEATTLE

NW 58TH Ave (Ballard Greenway)
39TH Ave NE (Wedgwood Greenway)
25th Ave (Central Area Greenway)

REFERENCES AND RESOURCES

SDOT: Neighborhood Greenways
Seattle Neighborhood Greenways
NACTO Urban Bikeway Design Guide

BICYCLE PARKING

Bicycle parking can be a single rack or a group of racks and can be installed on school grounds, on the sidewalk, or in the street.



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Bike racks on the sidewalk at Bryant Elementary School.



Bike corral at Pacific Crest School.



Covered bike parking at Nathan Hale High School.

WHAT IS THE PURPOSE OF BICYCLE PARKING?

1. Gives students and school staff a place to keep their bike during the day while they're at school
2. Encourages students and school staff to ride their bikes to school
3. Makes the main entrance to the school inviting for people who get to school by bike
4. Sends the message that the school encourages bicycling

HOW DOES SDOT DECIDE WHERE TO INSTALL BIKE PARKING?

1. We want to make sure that every school has enough bike parking to meet the day-to-day needs of students and staff
2. When deciding where to install bike racks, SDOT considers locations where the racks are:
 - a. noticeable immediately when arriving at school
 - b. visible from nearby windows and the street to make sure bikes are secure
 - c. sheltered from the rain
 - d. publicly accessible
3. We install bike racks that allow one or both wheels to be locked to prevent bikes from falling down and that can fit different types and sizes of bicycles, like small kid bikes or long family bikes.

BIKE CORRALS

Sometimes the best place to install bike parking is on the street. A bike corral can be installed in place of street parking and can provide parking for 6 to 12 bikes in place of one car.

A corral can also be placed in locations where parking isn't allowed, like 30 feet from an intersection or marked crosswalk. This helps make the crosswalk safer by ensuring no one parks their car illegally and blocks visibility of the crosswalk or intersection, while also adding parking spaces for people on bikes.

HOW MUCH DOES BIKE PARKING COST?

\$: Bike parking is relatively inexpensive

HOW LONG DOES IT TAKE TO INSTALL BIKE PARKING?

>1 year: We can generally install new bike parking at a school in less than one year

EXAMPLES IN SEATTLE

Bryant Elementary School
Nathan Hale High School
Pacific Crest School



REFERENCES AND RESOURCES

Seattle Department of Transportation: Bike Racks
Seattle Right-of-Way Improvement Manual
Safe Routes Partnership
Association of Pedestrian and Bicycle Professionals: Bicycle Parking Guidelines
Washington Sustainable Schools Protocol

