Safe Routes to School Briefing Sheets

Introduction

SAFE ROUTES TO SCHOOL BRIEFING SHEETS

This series of briefing sheets provides a hands-on reference for transportation professionals initiating or engaged in implementing safe routes to school (SRTS). The briefing sheets will aid practitioners in addressing infrastructure changes and in implementing plan components as part of a SRTS team.

The content includes:

- Introduction
- School Site Selection and Off-site Access
- Walking and Bicycling Audits
- School Route Maps
- Strategies to Improve Traffic Operations and Safety
- School On-site Design
- School Area Traffic Control
- Reduced School Area Speed Limits
- The Use of Traffic Calming Near Schools

THE SRTS PROGRAM

The program supports the planning, development, and implementation of projects and activities that improve the safety and accessibility of pedestrian and bicycle facilities to meet the needs of children travelers and to enhance understanding of safer walking and bicycling practices. Benefits of the program include promotion of more healthy and active lifestyles and reductions in traffic congestion, fuel consumption, and air pollution near schools.

The national SRTS program was established and funded under the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users Act (SAFETEA-LU) of 2005. It required each state and the District of Columbia to establish a full-time SRTS coordinator, and directed federal funding for both infrastructure and non-infrastructure projects. As established, the SRTS coordinator creates and implements the state program and administers the distribution of federal funds to local jurisdictions. Funding for SRTS programs may be pursued through federal programs that provide resources for pedestrian and bicycle programs. In addition, financial support may also be solicited via local capital and operating budgets, contributions from corporate or nonprofit foundations, and through grassroots fundraising activities.

Figure 1. SRTS Stakeholder Team. Source: David Parisi

In 2012, the program was modified in Moving Ahead for Progress in the 21st Century (MAP-21). SRTS projects are now eligible for funding through a new Transportation Alternatives program. The SRTS coordinator position is now optional subject to each state's priorities. While Congress proscribed administrative and funding changes, the program's goals remain the same—to encourage communities to create safer walking and bicycling routes in the vicinity of schools.

A TEAM EFFORT

A successful SRTS program is a multidisciplinary team effort that engages stakeholders early in the process. Stakeholders include school officials and staff, parents, students, public health professionals, law enforcement, transportation professionals, SRTS coordinators, community supporters, and municipal officials.

COMPONENTS OF A SRTS PROGRAM

The five Es—Engineering, Education, Enforcement, Encouragement, and Evaluation—are the components of a successful SRTS program. The National Center for Safe Routes to Schools Program Tool Database provides resources, guides, and case studies that specifically address each E in context for transportation professionals.[1] This briefing sheet includes an overview of the five Es.

Engineering

Creating operational and physical improvements to the infrastructure surrounding schools that reduce speeds and potential conflicts with motor vehicle traffic, and establishing safer and fully accessible crossings, walkways, trails, and bikeways.[2]

The top concerns often cited by parents regarding children walking and biking to school are safety at intersections, distance from school, speed of traffic, and amount of traffic.[3] As members of the stakeholder team, transportation professionals provide technical advice and identify engineering solutions to mitigate these concerns. The engineer's role may include:

- Creating school walking and bicycling route maps using a variety of assessment tools and exercises;
- Regulating traffic near schools;
- Providing solutions to common traffic problems at the school site;
- Providing and maintaining bicycle and pedestrian facilities along the school routes; and
- Minimizing conflicts to provide safer street crossings for bicyclists and walkers.

Education

Teaching children about the broad range of transportation choices, instructing them in important lifelong bicycling and walking safety skills, and launching driver safety campaigns in the vicinity of schools.[2]

Transportation practitioners know the "rules of the road"; as such their role may include educating parents, students, drivers, and community members by providing:

- Tip sheets with guidelines for safer ways to travel to and from school;
- Success stories from other communities;
- Engineering insights and principles to the local SRTS coordinator to enhance outreach materials, including Americans with Disabilities Act requirements; and
- Presentations in classrooms.

Figure 2. Safer bicycle skills. Portland, TX, USA. Source: Michael J. Cynecki

Encouragement

Using events and activities to promote walking and bicycling.[2]

Recognized annual activities such as International Walk to School Month (October) and International Bike to School Day (in May) are ideal times to initiate a SRTS program. Many SRTS programs have additional special events or incentives throughout the year to reward students and families for getting to school by foot or bicycle. These activities will often be initiated by the school or SRTS coordinator. The transportation professional can support these efforts by:

- Providing data and information unique to the community to support this activity;
- Preparing news releases to notify the public of infrastructure projects and their relation to the SRTS program; and
- Attending SRTS events to demonstrate local agency interest.

Facilitating participation in the national event and ongoing activities will create a more comprehensive approach to maintaining engagement in a SRTS program.

Enforcement

Partnering with local law enforcement to ensure traffic laws are obeyed in the vicinity of schools (this includes enforcement of speeds, yielding to pedestrians in crossings, and proper walking and bicycling behaviors), and initiating community enforcement such as crossing guard programs.[2]

Enforcement of traffic laws at and around schools can help prevent a child from being involved in a traffic crash. Law enforcement officers and traffic engineers are a resource and critical partners to the SRTS team. Safer traffic conditions may encourage more parents to allow their children to walk and bike to school. However, to be effective, law enforcement must coordinate its activities with the traffic engineer and school officials. Traffic engineers can work with law enforcement to:

- Identify problem locations that could benefit from a stronger police presence and enforcement activity;
- Provide vehicle speed surveys on major streets to target where police could use radar to enforce speed limits;[4]
- Use innovative devices, such as in-roadway crosswalk signs to alert motorists that children may be crossing, or speed feedback signs that inform motorists of their current speed;[5] and
- Provide safety education and training support for student safety patrols and adult crossing guards.

Evaluation

Monitoring and documenting outcomes and trends through the collection of data, including the collection of data before and after the intervention(s).[2]

Evaluation includes assessment of baseline conditions. This assessment phase includes team members working together to conduct walking and bicycling audits to identify barriers to safe walking and bicycling to school, surveying how students are traveling to and from school, and surveying parent and student opinion about walking and bicycling to school. It is important to know why students within close proximity of a school are not walking and what changes are needed to encourage walking and bicycling. Before-and-after documentation of the geometric and engineering changes on site, and assessments of behavioral and attitudinal changes once the program implementation is complete, are other components of evaluation. The results of these efforts are useful in maintaining engagement in the program, demonstrating success, and providing support for future funding requests.

These types of attitude and behavioral reviews should take place with the SRTS coordinator and other critical stakeholders to:

- Ensure that underlying problems are identified;
- Set reasonable expectations;
- Identify changes that can improve the program;
- Determine whether the program is meeting desired goals and allow for midcourse corrections; and
- Conduct before-and-after studies.

RESOURCES

The package of briefing sheets provides guidance on specific areas of practice for the transportation practitioner engaged in a SRTS program. Working with parents, school and law enforcement stakeholders, public health officials, and transportation professionals can create a supportive and engaging environment for a successful SRTS program. For additional information, the following Web sites are useful resources:

Institute of Transportation Engineers—http://www.ite.org/activeliving/index.asp and
http://www.ite.org/childhoodobesity/default.asp
National Center for Safe Routes to School—http://www.saferoutesinfo.org
Safe Routes to School National Partnership—http://www.saferoutespartnership.org
U.S. Department of Transportation—Federal Highway Administration Office of Safety—http://safety.fhwa.dot.gov/saferoutes

ACKNOWLEDGMENTS

The National Center for Safe Routes to School and the Institute of Transportation Engineers would like to thank the following authors and reviewers.

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2. SRTS Guidance: http://safety.fhwa.dot.gov/saferoutes/guidance
3. http://www.saferoutesinfo.org/sites/default/files/SRTS_baseline_data_report.pdf
4. http://www.sanramon.ca.gov/transp/trafficengr.htm
5. http://www.sanbenitorideshare.org/pdf/bikeway/San_Benito_Bikeway_Ped_Plan_DRAFT_Ch8.pdf

Safe Routes to School Briefing Sheets

School Site Selection and Off-site Access

INTRODUCTION

Many studies and programs, including Safe Routes to School, are currently geared toward promoting safety for pedestrians, bicyclists, and other users of nonmotorized modes of getting to and from school. These studies and programs typically cite two key benefits: (a) lowered vehicle demand and (b) exercise for children. The location of a school can influence levels of physical activity. Schools should be located to allow easy walking and bicycling for the children who will attend the school. Location varies considerably for elementary schools, middle or junior high schools, and high schools. Schools should provide pedestrian and bicycle access from all sides of their campus.

A central principle of traffic safety is to eliminate or minimize conflicts, such as those between streams of moving vehicles and between pedestrians and vehicles. When conflicts cannot be avoided, measures should be taken to minimize speeds. When designing a new school site, the various design components (buildings, driveways, walkways, bus loading areas, parking lots, etc.) should be positioned to eliminate or minimize conflicts.

SITE SELECTION

The selection of a site for a new school greatly influences the resulting design and operations of the facility. For example, if the site is located on a high-speed two-lane highway, there will be vehicles near the school traveling at high speeds and congestion will probably occur during drop-off and pick-up times due to the lack of turn lanes. Another example is a school site in a remote location with natural barriers, or built barriers such as railroad tracks. Few children will probably walk or bike to the school due to distance and limited travel paths. Siting a school within a (walkable) residential area will decrease vehicle trips and alleviate many of the conflicts discussed in this briefing sheet.

Many studies show that the distance between home and school is the strongest predictor of whether students walk or bike to school. According to National Household Travel Survey data[1] in 1969, 48 percent of K–8th grade students usually walked or bicycled to school. By 2009, only 13 percent of K–8th grade students usually walked or bicycled to school. School siting that supports walking or biking to school can influence levels of physical activity. Schools should be located in environments that contribute to the livability, sustainability, and public health of neighborhoods and communities.

The U.S. Environmental Protection Agency, in consultation with the Departments of Education and Health and Human Services, developed model guidelines for siting school facilities.[2] The *School Siting Guidelines* aim to encourage, inform, and improve consideration of environmental factors in local school siting decision-making processes. The guidelines specifically recommend:

- Locating a school such that a large portion of the student body lives within 1/2 mile (elementary) to 1 1/2 miles (high school) of the school; and
- Ensuring that safe routes to and from school are available for students.

It is desirable to locate school sites with appropriate access from the adjacent roadway, walkway, and bikeway networks. One of the widely accepted site selection criteria is to avoid locations with direct access to high-speed roadways. Others are to provide access from more than one direction to the immediate vicinity of the site, and provide access to the site from at least two adjacent streets. Access from more than one street has several potential benefits, including easier separation of parent and bus operations, better driveway spacing, and greater dispersion of traffic into and out of the site.

ROAD NETWORK

Schools need to be accessible from a street system capable of handling both school and nonschool traffic. Not only should current traffic volumes be manageable, but consideration must be given to reasonably anticipated growth in traffic. Other considerations include availability of right-of-way for sidewalks, bike lanes, and/or turn lanes (if not already present) and feasibility of establishing a reduced school speed limit zone. Accommodation of pedestrian and bicycle traffic is especially important in areas surrounding schools. The siting needs of an elementary school within the road network differ significantly from those of a high school. Elementary school siting should avoid streets that carry high volumes of traffic and higher speeds. Those streets are incompatible with the slow speeds of vehicles trying to access the school during school peak periods and with the pedestrian skills of younger children. Elementary and middle schools should be located on a collector street, and preferably at the intersection of two collector streets. Schools should not be located at the end of a cul-de-sac or have only one primary vehicle access.

SIDEWALKS

Sidewalks and designated paths leading to schools promote the use of nonmotorized modes of travel. For better pedestrian comfort, especially adjacent to high-speed traffic, it is desirable to provide a buffer space between the traveled way and the sidewalk. For rural sections without curb and gutter, sidewalks should be placed between the ditch and right-of-way line if practical. Sidewalks should be wide enough to accommodate the volume and type of pedestrian traffic expected in the area. They should be wider than minimum in the immediate vicinity of schools, where there are heavier pedestrian volumes.

Sidewalks will more likely be used if they are well-maintained and free of debris, encroaching shrubbery, and tree limbs. Bumps and uneven surfaces created by settling or underlying tree roots can cause tripping and discourage sidewalk use by students traveling by foot and in wheelchairs. Public works agencies must not pile snow on sidewalks when clearing snow from streets and should clear curb ramp accessways to sidewalks.

MAJOR CROSSINGS

One way to encourage pedestrian and bicycle access is to supplement marked crosswalks with crossing guards. It is also important to consider on-site crosswalks, particularly those across entrance driveways where vehicles may turn in conflict with pedestrians or bicyclists.

The provision of a student pedestrian and cyclist queuing area at major crossings could decrease conflicts between waiting students and traffic. Phoenix, Arizona, USA, developed wider student queuing areas and painted “stand-back lines” to delineate where students should stand while waiting at crosswalks for busy street crossings.[3]

The *School Area Traffic Control Briefing Sheet* also provides guidance on traffic control devices for major crossings, such as pavement markings, beacons, and signals.

ROAD ALIGNMENT

Adequate sight distance near school exits and entrances is important for safe and efficient traffic operations. If the school site is located on a tangent section of roadway that is relatively flat, then sight distance is typically not an issue. If the site is located along a road with horizontal and/or vertical curvature, then good visibility might be a challenge. An example of this concern is when the queue of vehicles in the parent drop-off zone extends beyond the driveway and vehicles on the adjacent roadway encounter stopped traffic just after rounding a tight horizontal or vertical curve.

Other guidance regarding alignment includes:

- All roads within the school site should have a maximum grade of 5 percent to avoid configurations that could impair a motorist’s vision.
- The location of driveways, buildings, landscaping, fences, block walls, and the school signs that typically mark the main entrance must permit adequate sight distances for drivers and pedestrians.
- The placement of the pedestrian crossing, along with the signs and markings selected for the crossing, should consider the existing horizontal and vertical curves on the approaches to the crossing.

TURNING LANES

The presence—or rather, the absence—of a turn lane, especially when considering the intense peaking associated with a school, can affect traffic operations around the school. The congestion, in turn, can influence the operations and safety of the pedestrian and bicyclist school trips. Some agencies have guidelines for the installation and design of turn lanes for access to adjacent sites, while others cite the AASHTO *Policy on Geometric Design of Streets and Highways*—also known as the Green Book—as a primary source for their turning lane criteria.[4] Installation of turn lanes is particularly important to consider when school sites are located on high-speed roadways, where separation of turning movements from through traffic provides operational and safety benefits.

School sites generate substantial peaks of traffic during relatively short periods. These peaks must be considered in the design and layout of turn lanes to school sites. When a turn lane is not provided, drivers will use a shoulder (if present) as a de facto right-turn lane or will cause stopped traffic on the neighboring streets. When a turn lane is insufficient to handle the queues, drivers will spill back onto the through lanes because of the high traffic demand and the inadequate length of the turn lane. In both of these scenarios, the resulting congestion will be associated with delay and weaving maneuvers as drivers attempt to bypass the queues.

The addition of a turn lane increases the distance pedestrians must walk when crossing the major roadway. Accompanying the turn lane with a raised median can provide pedestrians a refuge area within the crossing. If the location is signalized, the wider crossing could also affect the signal timing and may require a longer waiting period for pedestrians. The operational and safety trade-offs for vehicles, pedestrians, and bicyclists should be considered when deciding whether to install a turn lane.

ONE-WAY OPERATIONS

In certain situations, one-way operation of streets and school driveways can reduce or eliminate conflicts that cause congestion or safety problems. One-way operation can be considered when:

- A narrow street fails to function effectively under two-way operations either all or some of the time, such as during drop-off and pick-up times;
- Opposing left turns cause congestion;
- The preference is to eliminate cut-through traffic in a residential area; or
- There is a need to decrease turning conflicts, which could improve safety for the area.

A one-way street has advantages in reducing conflicts with turning traffic and in limiting the number of traffic directions conflicting with pedestrians. Disadvantages are that speeds may be higher than in two-way operations, and motorists must take a circuitous route to reach their destination. The direction of the one-way operation should be such that children do not need to exit their vehicle from the street side.

When a new one-way street is proposed—either as a temporary, part-time measure or as a full-time solution—a traffic analysis needs to be done to identify advantages and disadvantages to the pedestrian, bicycle, and vehicle traffic networks. The change could affect neighborhood traffic circulation and possibly even influence arterial-level traffic, depending on the location of the school. The traffic analysis should explore how best to implement the treatment, including whether the treatment should be part- or full-time and whether two-way bicycle traffic operation should be allowed with the one-way vehicle restriction.

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Safe Routes to School Briefing Sheets

Walking and Bicycling Audits

INTRODUCTION

Walking and bicycling audits are field visits to identify barriers or challenges to students using these modes to travel between home and school. Also known as assessments, audits generally include a tour of the school area,[1] where participants identify issues related to walking and biking, followed by a debriefing and brainstorming session to rank high-priority concerns and identify potential solutions. Participants systematically document information about the social, built, and natural environments that affect students walking or bicycling to and from school. This process fosters communication between local traffic officials and school stakeholders by bringing both groups together in the field.

Figure 1. Walking Audit Team. Source: David Parisi

Walking and bicycling audits provide community stakeholders with the information they need to analyze the design and condition of the transportation network. They provide specific facility and operational information to transportation planners and an engineer, which, allows experts to develop optimal walking and bicycling routes to school, target areas where changes are needed, and identify physical and policy solutions to improve the walking and bicycling environment.

IDENTIFYING KEY STAKEHOLDERS AND SETTING UP THE AUDIT

The most important element of a successful walk audit is strong participation from school stakeholders and from local engineering and enforcement officials. Stakeholders can include parents, children, school staff, school district officials, public works or traffic department staff, local engineers or planners, and law enforcement officials. The audit leaders can either invite a targeted list of key stakeholders or invite the general public via a flier or press release. School task forces and staff can promote the audit as part of regular communications among parents, teachers, and students. If a school already has a Safe Routes to School (SRTS) Task Force or Safety Committee, these groups are logical participants in the audit, as well as conduits to recruit additional participants.

Generally, personnel with experience in pedestrian and bicycle issues lead the audit, while participants gather information and share their experiences. Audits should preferably be scheduled during both the morning arrival and afternoon release periods to evaluate activities and conditions during times of peak demand.

PREPARING FOR THE AUDIT

In advance of the audit, background information can be collected via interviews and parent surveys. The school's SRTS Task Force and other key personnel should be interviewed to determine where students live, what key routes students take, and what policies the school has on walking, bicycling, busing, and student loading. Parent surveys may indicate how often students walk or bike to and from school and specific areas of concern. Surveys can determine how far most students live from school, which can help identify targeted strategies for encouraging alternatives to driving. Provide a map for audit participants to note specific locations of their comments and to identify problem areas on which to focus the audit. The map can simply be printed from an online source. At a minimum, the map should include an aerial with streets named and the school site indicated. It should show a half-mile radius around the school, and should be plotted at a large scale or individual maps should be provided to participants. Geographic information system-based data may be available or can be readily accessed, and can include presence of major streets, rivers, crash information, and motor vehicle volumes to help identify barriers. Maps can indicate the specific catchment area, or the distance from school that the average student or

family can reasonably be expected to walk or bike. If the district can provide school attendance boundaries, this information should be indicated on the map. The audit is a good opportunity to evaluate the walking and overall attendance boundaries.

Materials to bring to the audit include:

- Large-scale aerial map of the school area
- Smaller maps for each audit team
- List of previously identified issues
- Sign-in sheet for follow-up
- Checklists of information to gather
- Clipboards and pens
- Camera
- Water and other refreshments
- Reflective vests
- Interpreters as needed

CONDUCTING THE AUDIT

Participants should gather at the designated time, and the audit leader can provide materials and discuss the agenda. If there are multiple locations to cover and/or a large number of participants, the group can be divided into separate teams for the observation segment of the walk audit. A bicycling audit should be conducted on bicycles, and participants should pause to note conditions and user behaviors.

When conducting an audit, participants need to consider the perspectives children have when walking and bicycling to and from school. Keep in mind that younger children have difficulty seeing and evaluating traffic conditions because of their height; processing information because of their limited peripheral vision and visual acuity; correctly perceiving the direction and sound of traffic; and understanding the use of traffic control devices and crosswalks.

Within the school zone, participants should inventory facilities and behavior of students and parents. Many audit forms and templates are available online.[2]

The following information should be collected:

- School area traffic controls and sidewalks—presence and condition of all sidewalks and signs that serve the school, including signs indicating the school zone, speed limit, and drop-off/pick-up area;
- Drop-off/pick-up site—conditions of route for students getting dropped off/picked up;
- Route for students walking or bicycling to/from school—conflicts with driveways and/or traffic flow, presence of dedicated route up to the school entrance;
- Crossing guards—number and location, condition of crossing guard equipment (STOP paddles, safety vest, etc.), and level of training;
- Bicycle parking—presence, location, visibility, and use;
- School policy—separate dismissal time for students who walk or bike, policies for bus loading and parent drop-off/pick-up (designating separate entrances and loading zones, drop-off/pick-up queuing, timed arrivals or dismissal, student or teacher valets, etc.);
- School education and encouragement efforts—traffic safety, walking, and/or bicycling education; walking school buses; contests; events; etc.; and
- Visibility—adequate lighting, line of sight to pedestrian paths, presence of obstructions (light poles, signs, vegetation, parked buses or other vehicles, etc.).

As participants walk around identified locations of interest, they should observe the following information:

- Sidewalk conditions—presence and continuity of sidewalks, width, condition of the surface, buffer from the travel lane, obstacles such as utility poles, signs, or vegetation;
- Pathways—presence of formal or informal off-street paths or cut-throughs;
- Bikeways—bike lane characteristics (width, continuity, and presence of adjacent parking), bikeway signs and pavement markings, speed and volume of traffic, pavement condition, street crossing treatments or conflicts;
- Traffic patterns—streets where drivers tend to speed, intersections with a high rate of turning cars, conflicts between walking or bicycling routes and traffic patterns; and

- Visibility—whether pedestrian and driver sight distances are sufficient for pedestrians less than 5 ft. tall

At street crossings, interviews with crossing guards can identify ongoing or critical programs with circulation, including driver behavior, student behavior, or infrastructure issues. Information to collect at street crossings includes:

- Curb ramps—presence of curb ramps, presence of tactile strips at the base of the ramp, Americans with Disabilities Act compliance, number of curb ramps per corner, presence and condition of landing area (3-ft. flat section at the top of the ramp);
- Marked crosswalks—condition, type of pavement markings, presence of signs, visibility at the crosswalk, and whether the ramp is contained within the crosswalk markings;
- Traffic signals—pedestrian signals, push-button location and signing, countdown feature, audible pedestrian signal features, and sufficient crossing time. Verify that the push button works and is reachable by a person in a wheelchair; and
- Behavior—where the students cross the street, whether drivers tend to yield for students, whether speeding is a problem.

In addition, participants should gather information about potential personal safety issues, such as locations without street lights, locations where overgrown vegetation impedes visibility, areas with unleashed dogs or abandoned buildings, and areas of known (or suspected) crime.

DEBRIEFING THE AUDIT WITH PARTICIPANTS

After the observation and peak travel activity period is over, participants gather to discuss the issues that were identified and to begin identifying preferred routes, potential safety/nonmotorized improvements, and policies for bus and student loading. Participants should arrive at a consensus on the nature of the problems and begin identifying top priority issues for students, particularly those who walk or bicycle. The audit leader then summarizes the key issues, and participants can discuss how to prioritize addressing the issues. To conclude the walk audit, the audit leader should identify the next steps for reviewing the walk audit and mapping project results.

If desired, the audit can focus on arriving at consensus on the traffic issues. The audit leader can conduct additional fieldwork based on participants' observations and work with engineers to identify solutions. Participants can reconvene at a later date to discuss potential solutions and prioritize improvements.

COMPLETING THE AUDIT AND NEXT STEPS

After the audit, the leaders work with local authorities (city engineers and/or planners and school district staff who would be implementing the improvements) to identify potential short-term, low-cost solutions as well as longer term options. Solutions should include education, encouragement, and enforcement strategies in addition to engineering projects. Noninfrastructure examples include walking school buses, walking buddies, police or community enforcement, student loading policies, and student education on proper walking and bicycling behavior (see the National Center for Safe Routes to School *SRTS Guide* for a comprehensive source of strategies[3]). A list of action items or an action plan can be developed with timeframes and task leaders, which should be reported back to audit participants and other stakeholders.

Information from the audit can be used to develop a school route map. See the ITE Briefing Sheet—*School Route Maps* and the National Center for Safe Routes to School *Tips for Creating Walking and Bicycling Route Maps*[4] for additional guidance on developing these maps. Funding for infrastructure projects and encouragement, enforcement, and education may be available through your state SRTS program, managed by your state Department of Transportation or metropolitan planning organization (where the population is 200,000 or greater).

REFERENCES

1. The school area is generally the area within a half-mile from the school, depending on the enrollment boundary and barriers to walking and bicycling.
2. http://www.saferoutesinfo.org/program-tools/engineering-tip-sheets-assessing-walking-and-bicycling-routes-selection-tools.
3. http://guide.saferoutesinfo.org
4. http://saferoutesinfo.org/sites/default/files/walkbikeroutetipsheet.pdf.

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School Route Maps

INTRODUCTION

School route maps are effective tools for informing parents and students of traffic conditions and bicycle/pedestrian infrastructure around their schools. These maps can indicate the preferred, most convenient, and most accessible walking and bicycling routes to and from school and identify areas to avoid owing to high traffic volumes, lack of walkways, absence of controlled street crossings, and other conditions. These maps can show off-street trails, marked crosswalks, crossing guards, and pedestrian/bicycle facilities that assist students walking or bicycling, as well as challenging intersections, sidewalk gaps, and other barriers.

The 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) recommends the development of a school route plan: "The school route plan, developed in a systematic manner by the school, law enforcement, and traffic officials responsible for school pedestrian safety, should consist of a map showing streets, the school, existing traffic controls, established school walk routes, and established school crossings" (Section 7A.07).

BACKGROUND INFORMATION

School route maps can be developed through a variety of quantitative data, some of which may already exist:

- Aerial photographs—marked crosswalks, traffic-calming measures (speed humps, islands, curb extensions or bulb-outs), posted speed limits, and street width;
- Geographic information system (GIS) data
    - Primary information—roadways, sidewalks, bike lanes, shared-use paths, traffic control (crosswalks, traffic signals, etc.), railroads
    - Secondary information (if available)—presence of curb ramps, average daily traffic, and other more detailed information;
- School or school district—school enrollment, locations of crossing guards, walking attendance boundaries, and attendance boundary maps (if available);[1] and
- Parent surveys—distance most students live from school, identified problem areas, and how often students walk or bike to and from school.

Figure 2. Working with community to develop route plan. Source: David Parisi

In addition to this quantitative data, the school's Safe Routes to School (SRTS) Task Force (if one exists) and other key personnel should be interviewed to determine generally where students live (if not available from the district), what key routes students take, and what policies the school has on walking and bicycling.

WORKING WITH THE COMMUNITY

Once a preliminary map has been developed, stakeholders should be invited to provide feedback. Stakeholders can include parent volunteers, students, school officials, crossing guards, and other community members. Stakeholders can also provide the following information regarding barriers to walking and bicycling:

[1] Traffic control and crossing guard placement may be changed as a part of the school audit and mapping process. This process may also result in a change to the walking attendance boundary or school attendance boundary.

- Sidewalks—gaps or areas of poor sidewalk conditions (narrow, uneven, etc.);
- Challenging intersections—wide streets, high automobile speeds and volumes, lack of traffic control, insufficient signal crossing time, or extended pedestrian wait time for signals; and
- Areas with personal safety concerns—locations with abandoned buildings, unleashed dogs, no street lighting, overgrown vegetation (which impedes visibility), and known or suspected crime.

Community members and stakeholders should also confirm the routes identified in the quantitative analysis. Keep in mind that students may need to walk along both sides of the street.

There are a variety of methods to engage the community for feedback and additional information for the school route map. A school-area walking and bicycling audit can be held to bring technical experts and community stakeholders together to discuss and identify issues. See the ITE Briefing Sheet—*Walking and Bicycling Audits* for more information. An alternate strategy is to provide a mapping Web site where parents and other stakeholders can note specific locations and comment at their convenience. The National Center for Safe Routes to School offers a Map-a-Route, a Web site where users can indicate whether a route is for walking, bicycling, or both, and can note locations of crosswalks, stop signs, crossing guards, and traffic signals.[2] Another method is to use a GIS-based quantitative evaluation, which might consider available quantitative data.

MAKING THE MAPS USEFUL

School route maps are developed primarily for use by students and their parents, and they should be readable, attractive, and informative. Streets should be named and consistent graphics used to indicate features such as crosswalks, signals, and crossing guard locations. The legend should be clearly readable and include a scale bar. Color can be used to indicate the type of feature; reds and oranges may indicate caution or challenges, while blues, purples, and greens imply appealing routes. However, be mindful of how the map will read if copied in black and white or to a color-blind person. The map should provide relevant information for users and not be cluttered with extraneous detail. Distance and/or time references for different routes can be included.

The map should be limited to the radius from which students might walk or bicycle. This extent will depend on conditions around the school, including major barriers such as freeways, railroads, streams, topography, and residential density. It may be appropriate to expand the map to show key connections or intersections beyond the school-defined "walk area." The school route maps need to serve every residence in the walking attendance boundary, even though certain homes may not house students. Student housing may change as families move into areas or young children grow to school age.

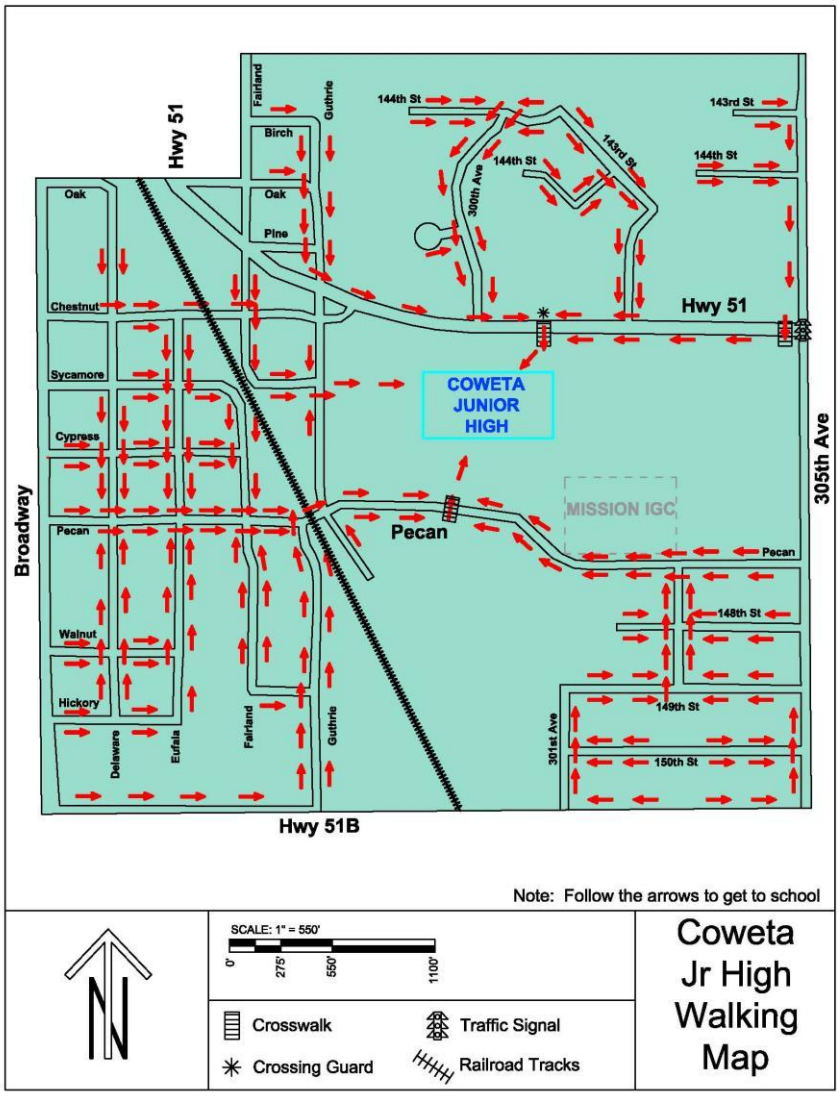


Figure 2. Walking Route Map. Source: City of Coweta, Oklahoma, USA

[2] http://maps.walkbiketoschool.org.

If additional space is available, informational or promotional text and graphics can be included on the back of the map. Examples include contact information or guidance for walking school buses or bike trains, reminders of appropriate walking and bicycling behavior, and key community contact information.

Maps should be translated into languages commonly used in the school. To address concerns about liability, the map should not be titled "Safe Routes to School Map," which indicates safety; rather, "Walking Routes to School" is recommended. In addition, a disclaimer should be included on the bottom of the map. The disclaimer might read, "This map is intended for information purposes only. The School or City assumes no responsibility for people using these routes." Where possible, maps should be revisited annually and updated with infrastructure and other changes such as crossing guard locations or school boundaries.

The maps should be made available online as well as in hard copy distributed through the school district. School route maps can be given to parents when they enroll their children in school and at the beginning of the school year. They can be useful in generating walking school buses or bike trains.

Safe Routes to School Briefing Sheets

Strategies to Improve Traffic Operations and Safety

INTRODUCTION

High volumes of traffic at schools during arrival and pick-up times can lead to poor traffic circulation and often unsafe conditions for bicyclists and pedestrians. For example, vehicle congestion and queuing during drop-off and pick-up times can conflict with pedestrian and bicycling circulation; students walking or bicycling to or from school may not use or have access to sidewalks or crosswalks; school parking areas may be unorganized and lack traffic controls and markings; buses may block visibility of pedestrians and bicyclists. Parents may engage in a variety of illegal or unsafe behaviors, including parking in a crosswalk, double-parking, speeding, parking in NO PARKING areas or fire lanes, ignoring turn restrictions, or parking in locations that encourage their children to cross a travel lane.

Safe Routes to School (SRTS) programs aim to improve safety for pedestrians and bicyclists. Changes to traffic operations during arrival and release can make a difference in safety for these modes. They may also improve traffic congestion, which can have the negative consequence of increasing traffic speeds and thus increasing risk for student pedestrians and bicyclists (see ITE Briefing Sheet—*Reduced School Area Speed Limits.* Therefore, before making changes to traffic operations, a thorough understanding of the dynamics of traffic operations around a school is needed. While traffic control and operations on a school campus are the responsibility of the school or school district, the local agency can provide school officials with guidance on how to better control and organize traffic on campus.

This briefing sheet discusses ways of improving traffic operations on the school grounds, outlining how issues are identified, how policies and engineering solutions are developed, and how solutions can be selected to address the issues. Solutions considered include valets, safety patrols, traffic enforcement, designated drop-off/pick-up sites, school policies, traffic control, and dedicated routes for pedestrians and bicyclists to the school.

IDENTIFYING ISSUES

The existing circulation patterns at schools should be evaluated to identify specific issues and problem areas. The evaluation should include either a walking or bicycling audit or interviews of relevant stakeholders and observations of school arrival or release procedures and behaviors. See ITE Briefing Sheet—*Walking and Bicycling Audits* for information to collect during an audit and the National Center for Safe Routes to School *Assessing Walking and Bicycling Routes: A Selection of Tools* for audits to consider using.[1] Participants may include school officials, parents and students, crossing guards, bicycle and trail groups, city traffic engineers, police officers, and local government officials.

DEVELOPING POLICIES AND SOLUTIONS

Treatments to address circulation issues include engineering, education, encouragement, and enforcement solutions, as well as school policies that address arrival and dismissal times and define expectations for parents and students.

Policies should be developed collectively with parent-teacher organizations, the local community, and the school board, as well as other stakeholders. Engineers can recommend policies related to arrival and dismissal, which complement infrastructure modifications. The group should convene to identify the issues, discuss solutions, and draft policy language. Parents should be notified about new policies via mailings, calls, meetings, e-mail, and/or social media.

In order for policies to be successful, the school site should be evaluated to maximize safety and clarity of traffic circulation. Extraneous signs should be removed and traffic control that is ignored should be removed or enforced. Education and encouragement programs can improve motorist and student compliance with traffic regulations and facilitate good behaviors.

Table 1: Standard solutions for common pedestrian and bicyclist/motor vehicle conflicts.

Conflicts between pedestrians/bicyclists/motor vehicles on school grounds	Potential Solutions
	Provide a sidewalk or pathway for students who are walking and bicycling
	Define a drop-off/pick-up site
	Designate access points for bus drivers, school staff, and parent drivers that are separated from pedestrians and bicyclists
	Vary dismissal time or location by mode or grade to reduce the number of students arriving at or leaving school simultaneously
	Reroute or restrict automobile access during key times in the day when conflicts occur
	Define zones within the school campus (student drop-off/pick-up, short-term parking, bus waiting area, etc.) and identify student and parent rules in each zone
	Use a platooning drop-off/pick-up system in which all vehicles unload/load simultaneously, and all drivers must wait for the front vehicles
	Require pedestrians and bicyclists to use the crosswalks
	Require students to enter and exit the vehicle on the same side of the street as the school
	Require parents of kindergarteners to park and walk their students to and from school
	See the ITE Briefing Sheet—*The Use of Traffic Calming Near Schools* for more information

Conflicts between pedestrians or bicyclists and motor vehicles on the school grounds can be caused by an undesirable school campus layout, which may require students walking or bicycling to cross the school driveway or parking lot. This problem can be addressed by developing, clarifying, or improving walking and bicycling routes through the school grounds. If possible, drop-off/pick-up areas should be separated from walking and bicycling routes.

Poor motorist behavior can be due to parent drivers ignoring or disobeying traffic controls. Clarifying and enforcing traffic controls should discourage parents from engaging in unsafe behaviors. Parents should be educated about proper behavior and the impacts of incorrect behavior through a variety of media, including mailings, discussions at Back to School Night with information in a parent handbook, and/or automated phone calls. Unsafe behaviors include double-parking, blocking the crosswalk, making U-turns, stopping in a traffic lane to drop off/pick up a student, parking in the drop-off area to walk a student into school, speeding, and using a cell phone while driving. Law enforcement or a school safety patrol can reinforce these rules, and parents who comply can be rewarded with incentives.

Table 2: Potential solutions for poor motorist behavior.

Poor Motorist Behavior	Potential Solutions
	Improve traffic controls—repaint or provide crosswalks, post speed limit signs, signalize pedestrian crossings, clarify and simplify traffic control, as appropriate
	Redesign circulation by designating one-way flow and pull-through lanes, or by realigning or constricting automobile access
	Discourage use of cell phones in the school parking lot
	Educate parents about unsafe driving behaviors and school transportation policies; reinforce these messages with regular communications about the rules and with driveway monitors
	Have parents pledge to abide by the laws and drive safely
	Encourage parents to comply with traffic controls with random rewards
	Educate school bus drivers about pedestrian and bicyclist safety issues, including maintaining slow speeds on streets surrounding the school
	Provide safety vests to crossing guards/student valets to reinforce authority
	Employ targeted police enforcement
	Issue school parking lot “citations” or warnings designed to look like actual police tickets

Poor student behavior may be due to a lack of awareness of "rules of the road," distractions, lack of student discipline, and unwillingness to travel out-of-direction. Education and encouragement strategies such as issuing paper "citations" for students dropped off in the wrong location or organizing walking school buses can inform students of correct behavior and train them to act in a safer and more consistent way.

Table 3: Potential solutions for poor student behavior.

Poor Student Behavior	Potential Solutions
	Provide supervision during arrival and release
	Move the crosswalk to a location where students currently cross
	Improve crosswalk visibility/repaint crosswalks; use signs, plantings, and other barriers to direct pedestrians to use the crosswalk
	Evaluate pedestrian signal timing to provide sufficient time for pedestrians to cross and to minimize pedestrian wait time
	Educate students in proper walking and bicycling rules of the road; provide yearly lessons that build safety skills
	Encourage walking school buses and bike trains
	Install fences to prohibit students from crossing at inappropriate locations

Congestion at the school inconveniences parents and is a safety concern for pedestrians and bicyclists due to distracted driving and queued vehicles blocking intersections and inhibiting visibility. However, when congestion results in slower motor vehicle speeds, it can have a beneficial effect on pedestrians. **It is important to remember that SRTS programs are not geared toward making it more convenient for parents to drop off and pick up children in private automobiles.**

However, sometimes traffic congestion is a hazard to pedestrians and bicyclists during arrival and pick-up times, especially when motorists exhibit noncompliant or erratic behaviors. When automobiles are queued up, students may have to cross between cars, where they are less visible to other drivers. A solution to this problem is the use of student valets who can open car doors for students and help them in or out of the vehicle, encouraging parents to stay in their vehicles. Additional operational modifications can improve traffic flow, thus reducing congestion. Policies and programs that encourage walking, bicycling, busing, and carpooling will also reduce congestion and improve safety at schools.

Table 4: Potential solutions for traffic congestion.

Congestion	Potential Solutions
	Encourage students who live near school to walk or bike
	Establish a priority parking and loading zone for carpool vehicles
	Allow students who live farther than 3 miles from school to ride a school bus
	Lengthen or reconfigure drop-off/pick-up area
	Provide a pull-through lane to the left side of the drop-off zone to allow drivers to drive past cars waiting at the curb and fill all curb drop-off/pick-up spots
	Designate a remote drop-off/pick-up area where students can walk to or from school
	Use student valets to streamline the drop-off/pick-up process
	Restrict parking in the neighborhood during school hours

Establishing a school transportation safety committee can help engage stakeholders and provide ongoing monitoring of traffic operations issues.

For more information, see also ITE Briefing Sheet—*School On-site Design*.

REFERENCE

1. http://www.saferoutesinfo.org/program-tools/engineering-tip-sheets-assessing-walking-and-bicycling-routes-selection-tools.

Safe Routes to School Briefing Sheets

School On-site Design

INTRODUCTION

A well-designed school site should support the safe arrival and departure of pedestrians and bicyclists. From a traffic operations perspective, increased walking and bicycling to school has the added benefit of potentially decreasing the need to accommodate long parent queues at drop-off and pick-up times. It is best for elementary and middle schools to be located within the community they serve, with pedestrian and bicycle access on all sides of the campus. This briefing sheet provides information on key elements to design or redesign a well-functioning school site.

SEPARATION OF PEDESTRIANS, BICYCLES, PARENT VEHICLES, AND BUSES

The physical routes provided for the various travel modes (buses, cars, pedestrians, bicycles, and delivery vehicles) should be separated as much as possible to provide safe and efficient access. Physical separation of the modes is both a design issue (for example, layout of separate driveways, loading areas) and an operations issue (for example, enforcement of bus-only zones, supervision of crosswalks). Enforcement may be needed to ensure that separation is maintained between the modes, such as not permitting parent cars to use the bus-only areas.

BICYCLE ACCESS AND STORAGE

To encourage bicycling, bicycle access and storage are needed at school sites, including bicycle lanes, shared lanes (produced by providing a wider lane for the inside travel lane), and in some cases trails on separate right of way. In addition, access needs to be provided between the roadway or trail and the bike parking racks at the school. Guidance on bicycle parking is available in the Association of Pedestrian and Bicycle Professionals *Bicycle Parking Guidelines*.[1]

Secure and effective bike parking is a crucial factor in encouraging children to cycle to and from school. Bike racks should be able to secure both wheels of a bike. Covered shelters should be considered to protect bikes from the elements. Lockable bike cages are very secure as they are locked during school hours and unlocked during school commute times. All bike parking areas should be easily monitored and in well-lit areas, as well as have convenient access to school building entrances.

Figure 1. Elementary school bicycle facilities in Beaumont. TX, USA.
Source: Michael J. Cynecki

It is advantageous to provide secure bike parking on two sides of the school so that bicyclists do not have to go across campus to a bike rack. Bike safety helmet use should be required or strongly encouraged.

LOCATION OF SCHOOL ENTRANCES

Building entrances should be located with consideration for pedestrian "desire lines." This entails determining the directions and points from which pedestrians are likely to approach the building and then identifying whether the design has inadvertently placed any unacceptable traffic conflicts or obstacles in the pedestrians' routes. An example of such an undesirable conflict is a school entrance that funnels pedestrians toward an uncontrolled midblock location or across a busy driveway. Pedestrians generally prefer the shortest crossing distance and may not walk as few as 100 ft. to cross at a controlled crossing. The location of school entrances should be adjusted to direct pedestrians to the location of the preferred crossings and avoid unnecessary driveway crossings.

BUS-RELATED DESIGN AND OPERATIONS

The subjects of bus operations, safety planning, and facilities design have all received considerable research. Guidelines include:

- Single-file right wheel to the curb is the preferred staging method for buses;
- Provide two outbound lanes if possible: one for left-turning and one for right-turning buses;
- Drop-off area design should not require backward movement by buses;
- Bus drop-off areas should be one-way in a counterclockwise direction to ensure that the loading/unloading of students occurs from the right-hand side of the vehicle adjacent to the building;
- The design of the bus drop-off areas should not require children to walk between buses;
- The bus-loading zone should not straddle a pedestrian crossing; and
- For efficiency, bus traffic should not share a common driveway with parent traffic.

DESIGN AND OPERATION OF DROP-OFF AND PICK-UP ZONE

Well-designed drop-off and pick-up zones can minimize illegal standing or parking near schools and help prevent problems such as blocking bus driveways and flow on adjacent roadways. Guidelines include:

- Drop-off/pick-up zones should be one-way in a counterclockwise direction so that students are loaded and unloaded directly to the curb/sidewalk. This practice will minimize pedestrian/vehicle conflicts in the drop-off/pick-up zone because students will not be exposed to traffic;
- Maximize fronting curb space at the loading zone by locating the loading/unloading area at the far end of the zone;
- Provide an adequate driveway length for queuing cars on site. The length of the car pick-up zone should be determined as a function of the expected number of cars;
- Drop-off area design should not require backward movement by vehicles;
- Do not load or unload students where they have to cross a vehicular path before entering the building;
- Student safety patrols and loading supervisors should be well trained and wear highly visible reflective safety vests. Safety vests should be replaced if they are worn or faded;
- Provide maps and instructions to parents on the school Web sites and in newsletters to describe the location and operation of the loading zone; and
- Due to increased dwell time, the space requirements for pick-up can be much longer than for drop-off. Separate policies for pick-up and drop-off may be necessary.

Improvements in pick-up/drop-off zones could result in increased speed on adjacent streets because congestion has been relieved. They could also discourage walking, biking, or bus use because the process is so convenient. The school may need to consider other measures, such as enforcement, to have appropriate speeds on the adjacent street, and incentive programs to encourage walking, biking, or bus use.

Student loading should occur in designated zones to minimize pedestrian/vehicle conflicts. Research[2] has shown that school type is related to the number and type of conflicts. Elementary school sites, which typically have additional supervision and good parental drop-off/pick-up behaviors, such as not dropping off children in parking lots or on the road, tend to have few conflicts. Middle schools typically have less staff supervision and parents who are willing to drop off or pick up children away from the designated student loading zones. When the parking layout is conducive, parents may use it to bypass the drop-off/pick-up queue. This type of loading is undesirable because children can be difficult to see when they emerge from rows of parked vehicles. Loading on an adjacent street can also be undesirable, such as when the vehicle blocks through traffic, when parents and students jaywalk across the street, or when the vehicle is parked in a no-parking zone. When the vehicle is parked on the opposite side of the street, students may need to cross vehicular paths, which is undesirable. Student drop-off in the neighborhood can also result in complaints from neighbors living adjacent to the school. A potential approach is to use remote student loading locations in nearby city parks, community centers, and churches to help eliminate some of the traffic from the campus.

DRIVEWAYS AND INTERNAL ROADWAY NETWORK

School driveways should conform to local design and access management guidelines for number, spacing, location, and layout. Suggestions specific to schools include:

- Use separate driveways for parent traffic and bus traffic at elementary and middle schools. Additional driveways may be needed at a high school, depending on the student population;
- Have space between driveways to accommodate the installation of a properly designed left-turn lane that can handle the anticipated queue length for drop-off and pick-up times;
- Locate the bus area so that buses exit upstream of automobiles and gain priority, thereby reducing delay;
- When selecting the location of driveways, consider the predominant direction of traffic and student origins so most drivers turn right when exiting the school;
- Students should not be required to cross busy driveways to access the school building;
- Ensure that roads within the school site have a maximum grade of 5 percent to avoid configurations that could impair a motorist's vision;
- Locate buildings, landscaping, fences, block walls, and school signs to permit adequate sight distances for drivers and pedestrians; and
- Locate driveways to avoid interlocking left turns with other streets or bus driveways.

Adequate on-site queue storage length to accommodate parent vehicles during drop-off and pick-up operations is important. Tools such as the school calculator available from the North Carolina Department of Transportation[2] and a recent study in Texas[3] provide guidance regarding queue storage length. It is good practice to use the afternoon pick-up data to predict the maximum queue of vehicles. Another study in Texas[4] found that the on-site elementary school queue design length in number of vehicles is approximately 6 percent of the total enrollment in students; however, this may increase if the school campus and placement are not well designed for walking and bicycling.

PARKING

Many school districts utilize local requirements, typically from a municipality, for the parking requirements at schools. The local requirements for total number of spaces often vary based on school type (high, middle, or elementary schools). Most school architects also use standard graphics software packages for the design of lots or parking spaces (angled, parallel, or conventional). General guidance for schools is to separate parking areas (student, staff, visitors, and buses) from student loading/unloading areas and delivery loading zones and to separate student pedestrians and bicyclists from both. Also, avoid driveways that allow parents to take shortcuts through parking lots to drop off or pick up students; this type of parking layout encourages students to cross vehicular paths.

Short-term parking spaces should be identified beyond the student loading area and near the building entrance. These spaces can be used by parents requiring an extended time to load or unload. The availability of short-term parking keeps the loading area clear of parked vehicles and can result in safer and more efficient operations.

SUPPLEMENTAL DEVICES TO MINIMIZE PEDESTRIAN/VEHICLE CONFLICTS

The design of the school grounds plays a large role in dictating traffic circulation at the site. In addition to physical layout and geometric elements (for example, driveway width or number of lanes), schools can use traffic cones and other channelizing devices to control on-site traffic patterns. Examples of practices include:

- Place traffic cones for traffic control or access restriction. More lanes in the parent zone are associated with increased pedestrian/vehicle conflicts. Cones can be used to create a single-lane queue in the drop-off/pick-up zone. This practice is desirable because it minimizes the potential for pedestrian/vehicle conflicts; however, it can be used only if there is enough capacity to process the queue efficiently using only one through lane;
- Place cones or a traffic gate to restrict vehicles, typically parent vehicles, from accessing a zone designated for other uses (for example, parking, bus loading, pedestrian/bicycle zone); and
- Replace discolored traffic cones with new orange cones.

TRAFFIC CONTROL DEVICES

All signs and markings within school sites should comply with the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD)[5] or with state documents if the state has its own manual or state supplement to the 2009 MUTCD. The MUTCD is the definitive source for guidance on signing, pavement marking, and traffic control. If traffic control devices, signs, and pavement markings within school sites comply with the MUTCD, drivers, pedestrians, and bicyclists are more likely to operate in a uniform manner consistent with off-site operations. Examples of common violations and other problems related to signs and pavement markings at school sites include:

- Use of yellow paint for noncenterline applications such as directional arrows. Exceptions: yellow pavement markings are required in California for school traffic control and are required in Arizona for 15-mph zone crosswalks.
- Signs mounted below standard heights;
- Signs with inconsistent text color;
- Nonstandard signs;
- Leaning posts and bent signs;
- Faded or defaced signs or those that are no longer reflective; and
- Too much text or too many messages on a sign.

It is best for local agencies to create an inventory of signs and pavement markings in the right of way for each school and to inspect these signs/markings annually. School officials can do the same for the signs and pavement marking placed on their campus.

Additional information on traffic control devices for schools is available in the ITE Briefing Sheet—*School Area Traffic Controls*.

REFERENCES

1. Association of Pedestrian and Bicycle Professionals (APBP). *Bicycle Parking Guidelines*, 2nd Edition. Washington, DC, USA: APBP, 2010.
2. http://ncdot.org/doh/PRECONSTRUCT/traffic/congestion/cm/msta/schools.html.
3. Cooner, S.A., K. Fitzpatrick, M.D. Wooldridge, G.L. Ford. *Traffic Operations and Safety at Schools: Recommended Guidelines*. Report No. 0-4286-2, College Station, TX, USA: Texas Transportation Institute, 2004.
4. Qualls, D. *Strategies for the Greening of Student Pick-Ups at School Dismissal*. Washington, DC, USA: Institute of Transportation Engineers, 2010.
5. Federal Highway Administration (FHWA). *Manual on Uniform Traffic Control Devices*. Washington, DC, USA: FHWA, 2009.

Safe Routes to School Briefing Sheets

School Area Traffic Control

INTRODUCTION

To achieve uniformity of traffic control in school areas, comparable traffic situations need to be treated in a consistent manner. Part 7 of the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) and the Institute of Transportation Engineers (ITE) *Traffic Control Devices Handbook* provide information on traffic control devices related to schools. The traffic tools used to manage traffic near and at schools include signs, pavement markings, beacons, and traffic signals.

SIGNS

School Sign

The basic sign for schools is the School (S1-1) sign. The 2009 MUTCD assigns various purposes to this sign. Figure 1 shows an example of the sign installation. It has four applications:

- To warn road users that they are approaching a school, a school crossing, or school-related facility adjacent to the highway;
- To identify the beginning of a school zone (some jurisdictions officially designate school zones and grant them special standing in law, such as increased fines imposed for speeding);
- When combined with an AHEAD or distance plaque, to warn road users that they are approaching a school crossing; and
- When combined with a diagonal downward-pointing arrow plaque, to indicate the location of a school crossing.

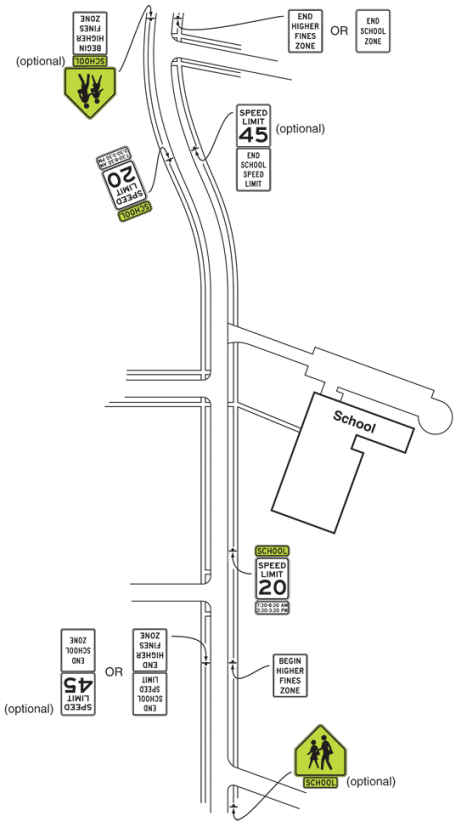


Figure 1. Example of school zone sign placement from MUTCD[1]

According to the MUTCD, school warning signs, including the "SCHOOL" portion of the School Speed Limit (S5-1) sign and including any supplemental plaques used in association with these warning signs, shall have a fluorescent yellow-green background with a black legend and border unless otherwise provided in the MUTCD for a specific sign.

Changeable Message Signs or Driver Feedback Signs

The 2009 MUTCD allows a changeable message sign (CMS) to be used in lieu of a static sign to display a reduced speed limit within a school zone. When illuminated, the CMS must conform to the basic shape, message, layout, and color of the static assembly, including the display of the SCHOOL message in fluorescent yellow-green pixels and the other messages in white pixels on a black background.

Driver feedback displays or signs are used to advise approaching motorists of the actual speeds at which they are traveling. These signs must display a yellow YOUR SPEED XX MPH or similar legend on a black background or the reverse of these colors. Experience has shown that driver feedback displays are more effective when used in conjunction with a speed limit sign and should be in use only during active school zone periods.

In-Street Pedestrian Crossing Signs

In-street pedestrian crossing signs (MUTCD R1-6 and R1-6a signs) are intended for use at uncontrolled crosswalks. The signs can be installed on the centerline or in the median with either a portable or fixed base. In some locations, these signs are present only when the crossing guard is present. Because the signs are located between the lanes, they can have a traffic-calming effect from the narrowing of the lanes. While research on the effectiveness of in-street school crossing signs is not available, research on the effectiveness of in-street pedestrian crossing signs has shown these signs to increase driver yielding[3–7] between 13 and 46 percent depending on the location. Field studies from TCRP Report 112/NCHRP Report 562[8] indicate that in-street signs have relatively high motorist yielding (ranging from 82 to 91 percent) for study sites on two-lane streets with posted speed limits of 25 or 30 mph (40 or 48 km/h). Lessons learned from the studies include:

- When drivers frequently strike the signs, consider placing the signs on median islands to extend their useful live; and.
- The characteristics of the roadway are associated with the effectiveness of the device. In-street pedestrian crossing signs are more effective with lower speed limits, narrower or fewer numbers of lanes, lower average daily traffic, and lower left-turn volumes.

PAVEMENT MARKINGS

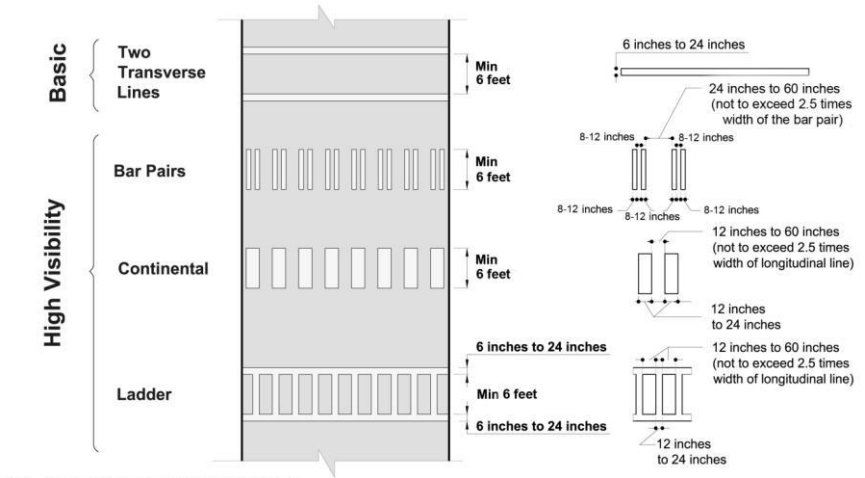
Advance Stop or Yield Line and Sign

The advance stop/yield line treatment places the traditional stop or yield line 20 to 50 ft. upstream of the crosswalk. The lines are often accompanied by STOP HERE FOR (or YIELD HERE TO) PEDESTRIAN signs. Advance yield lines address the issue of multiple-threat crashes on multilane roadways, where one vehicle stops for a pedestrian in the crosswalk but inadvertently screens the pedestrian from the view of drivers in other lanes. Several studies have documented that advance yield lines decrease pedestrian-vehicle conflicts and increase driver yielding at greater distances from the crosswalk.[9–12] Advance stop lines are to be used where the state law requires drivers to stop for pedestrians in a crosswalk. Advance yield lines are to be used where the state law requires drivers to yield to pedestrians in a crosswalk.

Marked Crosswalks

Crosswalk markings provide guidance for pedestrians by defining and delineating paths. Crosswalk markings are classified as basic or high visibility. Basic crosswalk markings consist of two transverse lines. High-visibility markings consist of longitudinal lines parallel to traffic flow with or without transverse lines. Figure 2 presents examples of crosswalk markings.

A late 1990s study on crosswalk pavement markings found that as traffic volumes, speeds, and street widths increase, greater crash frequency was present when only crosswalk markings (no signs or beacons) were used as compared with no crosswalk markings.[13,14] The study recommendations indicate that the issue should not be whether to provide crosswalk markings on these high-volume, high-speed streets. Instead, the recommendations point to the necessity of providing other treatments in addition to crosswalk markings that will make a street crossing safer for pedestrians. The implication is that marked crosswalks ALONE are not sufficient on multilane streets with high traffic volumes and speeds.



Note: At a non-intersection uncontrolled pedestrian crossing where the speed limit is greater than 35 mph, the high visibility crosswalk marking, if used, should not be less than 8 feet wide.

Figure 2. Crosswalk marking examples. Source: Texas Transportation Institute.

TCRP Report 112/NCHRP Report 562, in Appendix A, provides guidelines on pedestrian crossing treatments to consider at uncontrolled intersections.[8] It includes worksheets that can be used to select treatments based on total pedestrian delay at the crossing.

SIGNALS AND BEACONS

Rectangular Rapid-Flashing Beacon

The rectangular rapid-flashing beacon (RRFB) flashes in an eye-catching sequence to draw drivers' attention to the sign and the need to yield to a waiting pedestrian. Each side of a light-emitting diode flasher illuminates in a wig-wag sequence (left and then right) similar to the flash pattern of an emergency vehicle. A recent study[15] evaluated RRFBs at 22 sites and found that RRFBs were effective in encouraging drivers to yield to pedestrians. During the baseline period, the average yielding for all of the sites was 4 percent before installation of the RRFBs. Data collected over a 2-year period at 18 of the sites confirmed that the RRFBs continue to encourage drivers to yield to pedestrians, even over the longer term. By the 2-year follow-up, the researchers determined that the introduction of the RRFB was associated with yielding that ranged between 72 and 96 percent. Therefore, the evidence for change was overwhelming and persisted for the duration of the study.

In July 2008, the Federal Highway Administration (FHWA) issued an interim approval for optional use of RRFBs as warning beacons to supplement standard pedestrian or school crossing signs at crosswalks across uncontrolled approaches. (See http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/fhwamemo.htm.) Agencies need to obtain FHWA approval at the state or local level before using the RRFB.

The city of Garland, Texas, USA, has expanded the RRFB concept for use with a school crossing. Figure 3 shows the sign used in Garland. Data for one site showed that compliance rates of drivers yielding to staged pedestrians improved markedly with the RRFB device in place, from less than 1 percent before installation to approximately 80 percent after. Compliance rates of drivers during school zone periods were similar between the before and after periods, typically between 80 and 100 percent, because of the presence of a crossing guard.

Figure 3. Example of the rectangular rapid flashing beacon being used with school sign. Source: Texas Transportation Institute.

Pedestrian Hybrid Beacon

The pedestrian hybrid beacon (PHB) (also known as the HAWK) is located both on the roadside and on mast arms over the major approaches to an intersection (see Figure 4 for an example). The head of the PHB consists of two red lenses above a single yellow lens. It is normally "dark," but when activated by a pedestrian, it first displays a few seconds of flashing yellow followed by a steady yellow change interval, and then displays a steady red indication to drivers, which creates a gap for pedestrians to cross the roadway. During the flashing pedestrian clearance interval, the PHB changes to a wig-wag flashing red to allow drivers to proceed after stopping if the pedestrian has cleared the roadway, thereby reducing vehicle delays.

The device was developed in Tucson, Arizona, USA, which now has more than 100 installations, many at school crossings. A recent study conducted a before-and-after evaluation of the safety performance of the pedestrian hybrid beacon[16] and found:

Figure 4. Example of a Pedestrian Hybrid Beacon (HAWK) treatment in Tucson, AZ, USA. [16]

- A 29 percent reduction in total crashes (statistically significant);
- A 15 percent reduction in severe crashes (not statistically significant); and
- A 69 percent reduction in pedestrian crashes (statistically significant).

FHWA added the PHB to the 2009 MUTCD (Chapter 4F). The MUTCD includes guidelines for the installation of the PHB for low-speed roadways where speeds are 35 mph (56 km/h) or less, and for high-speed roadways where speeds are more than 35 mph (56 km/h).

Traffic Signal

Signal Warrant 5 (School Crossings) within the MUTCD is for the use of traffic control signals at established school crossings on major streets. Pedestrian signal heads/indications are required for traffic control signals installed at established school crossings. Where the pedestrian change interval is longer than 7 seconds, the signal must have a pedestrian countdown display to indicate the number of seconds remaining in the change interval.

OTHER SCHOOL AREA TRAFFIC CONTROLS

Other methods of traffic control may be used in school zones. Geometric features are also used and are discussed in ITE Briefing Sheets—*School On-site Design* and *School Site Selection and Off-site Access.* Reduced-speed school zones are discussed in ITE Briefing Sheet—*Reduced School Area Speed Limits*. Several signs and markings used around schools are discussed in Part 7 of the MUTCD.[1] Consult the MUTCD or ITE *Traffic Control Devices Handbook*[2] for details.

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Safe Routes to School Briefing Sheets

Reduced School Area Speed Limits

INTRODUCTION

Higher vehicle speeds are strongly associated with a greater likelihood of both a pedestrian crash and serious pedestrian injury. A 1999 National Highway Traffic Safety Administration study found that 5 percent of pedestrians are fatally injured when struck by a vehicle traveling at 20 mph or less. This compares with fatality rates of 40, 80, and nearly 100 percent when the pedestrian is struck at 30, 40, and 50 mph or more, respectively.[1]

Simply setting a reduced speed limit in a school zone is not likely to produce the entire desired speed reduction on its own. Tools used to assist in reducing vehicle speeds in school zones include police enforcement (for example, conventional, automated speed cameras, double fines), public awareness campaigns, and engineering countermeasures. Traffic engineering tools include school speed limit zones and traffic calming (such as curb extensions or raised crosswalks). See ITE Briefing Sheet—*The Use of Traffic Calming Near Schools* for more information. Applying a combination of measures in conjunction with a reduced speed limit is more likely to slow traffic.

SCHOOL SPEED ZONES

Many parents and school and community groups request that the school speed limit be reduced by the greatest possible extent, with the expectation that motorists will obey the posted speed limit. While speeds are lower in a school speed limit zone as compared to when the posted regulatory speed is in effect, the average operating speed does not always reach the posted school speed limit even when combined with flashing lights. Research shows that the measured 85th percentile speed is about 5 to 7 mph higher than the posted school speed limit (see Figure 1).[2] Therefore, while a school speed limit zone does have lower speeds, drivers still exceed the posted school speed limit.

Principal questions with reduced school speed limits include:

- Should speed limits be reduced for the school?
- What limit should be selected for the reduced school speed limit?
- Where should the reduced school speed limit zone begin and end?
- When should the reduced school speed limit be in effect?

The answers to these questions vary widely between states and individual jurisdictions. In many cases, some of these issues are settled by state statute or local ordinance. In the absence of state or local requirements, a jurisdiction should establish uniform procedures for considering the need for and the implementation of school speed limit zones.

Should Speed Limits Be Reduced for the School?

The evaluation process needs to measure existing speeds on the street in question during school hours and determine whether speeds are higher than desired. The evaluation process should consider whether other actions might bring about the desired results more effectively.

A school speed limit zone typically is considered when children are crossing a roadway going to and from school. The zone may be considered on any street along the school frontage.

In some regions, school speed limit zones are generally not used when signalized or stop-controlled intersections are present at the school crossings, because their traffic control creates gaps that children can use to cross a roadway. A school speed limit zone may be installed or retained at a roundabout, at a signalized or stop-controlled intersection (for example, as a mitigation measure for concerns related to sight distance), or in other situations as determined by an engineering study.

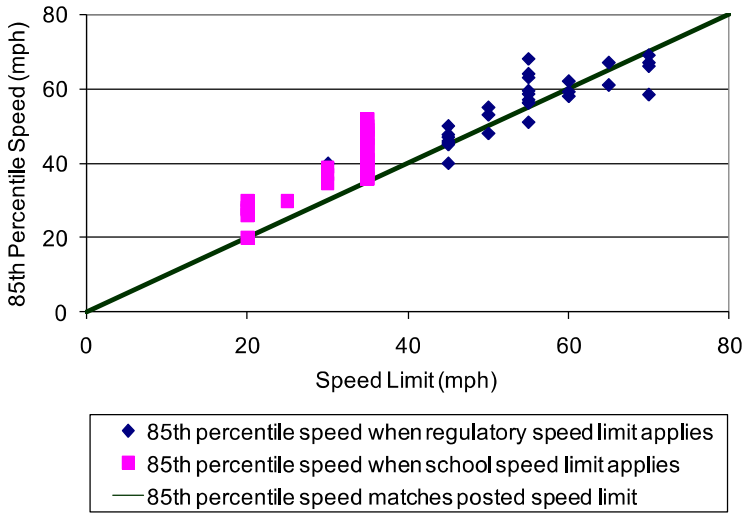

Figure 1. Measured 85th percentile speeds for school sites in Texas when reduced school speed limits are and are not active.[2]

Young students need slower speeds in school zones because children do not have the same abilities as adults in:

- Seeing and evaluating traffic conditions because of their height;
- Processing information because of their limited peripheral vision and visual acuity;
- Perceiving correctly the direction and sound of traffic; and
- Understanding the use of traffic control devices and crosswalks.

What Speed Limit Should Be Selected for the School Zone?

The value used for the reduced school speed limit varies and is influenced by state and local laws. In some states, the value is the same for all reduced-speed school zones. In other locations, the value must fall within a range depending on the established speed limit or is entirely determined on a case-by-case basis. See Table 1 for examples of school speed limit zone values.

Table 1. A Sample of School Speed Limit Zone Values

State	**Speed Limit in School Zone**	
Arizona[3]	15 mph	
Delaware[4]	20 mph	
Iowa[5]	No fixed value. Locations are evaluated on a case-by-case basis, usually 10 mph below posted speed limit.	
Massachusetts[6]	20 mph	
Minnesota[7]	No more than 30 mph below the established speed limit and no lower than 15 mph.	
Montana[8]	No fixed value. Locations are evaluated on a case-by-case basis.	
New Hampshire[9]	10 mph under the posted speed limit.	
New Jersey[10]	25 mph	
Ohio[11]	20 mph	
Oregon[12]	20 mph	
Pennsylvania[13]	15 mph	
South Dakota[14]	15 mph	
Texas[15]	**85th Percentile Speed**	**Suggested School Speed Limit**
	Below 55 mph	Not more than 15 mph below 85th percentile speed or posted speed. Not to exceed a 35 mph school speed limit.
	55 mph	20 mph below the 85th percentile speed or posted speed.
	Greater than 55 mph	Use buffer zone to transition to a 35 mph speed limit.
Washington[16]	20 mph	

Speed studies provide a sound basis for selecting the proper speed limits for school zones. While it is not common practice to set speed limits significantly lower than the 85th percentile speed for regulatory speed zones, exceptions to this practice are often found in school zones.

Factual studies, reason, and sound engineering judgment, rather than emotion, should govern the final decision on the maximum deviation from the 85th percentile speed that will provide a reasonable and prudent school speed limit.

Where Should the School Speed Limit Zone Begin and End?

In some states, the start and end of the school speed zone are established by state law. The *Manual on Uniform Traffic Control Devices* (MUTCD) states that the beginning point of a reduced school speed limit zone should be at least 200 ft. in advance of the school grounds, a school crossing, or other school-related activities. This 200-ft. distance should be increased, however, if the reduced school speed limit is 30 mph or higher. Researchers suggest the beginning of the school speed limit zone be based upon the school speed limit as follows:[2]

Table 2. Suggested beginning of school speed limit zone

School Speed Limit (mph)	Distance to Crosswalk or First Driveway (ft.)
20	200
25	200
30	300
35	400

The location of the beginning and end of a school speed limit zone should be based on engineering judgment rather than the exact location of the school property line or fence. The school speed limit zone should be centered at the location(s) where children cross the roadway. The beginning and ending points should be selected with appropriate consideration for the location of other traffic control devices and/or features that could affect the effective implementation of the school speed limit zone.

School speed limit zones in urban areas, where speeds are 30 mph or less, may have school zones as short as 400 ft. School speed limit zones in rural areas, where regulatory posted speeds are typically 55 mph or more, will have longer school zones. The suggested length of school zones in rural areas is 1,000 ft.

Research has shown that speeds are approximately 1 mph higher for every 500 ft. driven within a school zone; therefore, longer school zones are associated with greater speed variability within the zone.[2]

When Should a Reduced School Speed Limit Be in Effect?

Generally, the reduced school speed limit zones should be in effect only during specified intervals such as at the start and end of a school day. While the transportation agency responsible for the roadway operations and maintenance installs the signs, the times are generally set through consulting with the local school district. Close cooperation is needed between school officials and those who operate the roadway.

Figure 2. Example of school speed limit sign. Source: Aliyah N. Horton

In some locations, the intervals of operation of the flashing beacons (if used) on the school speed limit sign assemblies may be extended or revised for school events, as agreed upon by the school district and the entity responsible for operating the flashing beacons. In this case, the flashing beacons should be in operation only when there is an increase in vehicular activity and/or pedestrian or bicycle traffic in and around the roadway associated with the school event.

Research has also shown that operating speeds in an active school speed limit zone are at their lowest close to the start time or end time of the school day.[2] Approximately 20 minutes past these times, the speed increases 1 mph. Automated flashers (example shown in Figure 2) used with reduced school speed limit assemblies must be coordinated with school officials for half-day sessions and early release to ensure that the reduced speed is in effect during school crossing times. Local traffic officials need to coordinate with school officials each year to ensure that the traffic control plans fit the school arrival and dismissal schedule.

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Safe Routes to School Briefing Sheets

The Use of Traffic Calming Near Schools

INTRODUCTION

Parents often cite high vehicle speeds and traffic volumes as reasons for not allowing their children to walk or bicycle to and from school. Calming traffic through the application of engineering tools can encourage drivers to reduce their speeds. At lower operating speeds, drivers are better able to react in time to avoid collisions (see Figure 1). This is particularly important around children, who may behave erratically or may not be alert to traffic. "Traffic calming" is the installation of physical measures that alter driver behavior and improve conditions for nonmotorized street users. More specifically, traffic calming objectives include:

- Achieving slow speeds for motor vehicles;
- Reducing collision frequency and severity;
- Increasing safety and the perception of safety for pedestrians and bicyclists;
- Reducing the need for police enforcement;
- Enhancing the street environment (for example, streetscaping);
- Increasing access for all modes of transportation; and
- Reducing cut-through motor vehicle traffic.

This briefing sheet focuses on physical changes to roadways to achieve traffic calming, specifically to achieve improved safety and accessibility for pedestrian and bicycle routes implemented through Safe Routes to School (SRTS) programs. Such changes are generally more self-enforcing than traditional education and enforcement efforts, offer long-term benefits, and usually do not require continued intervention.

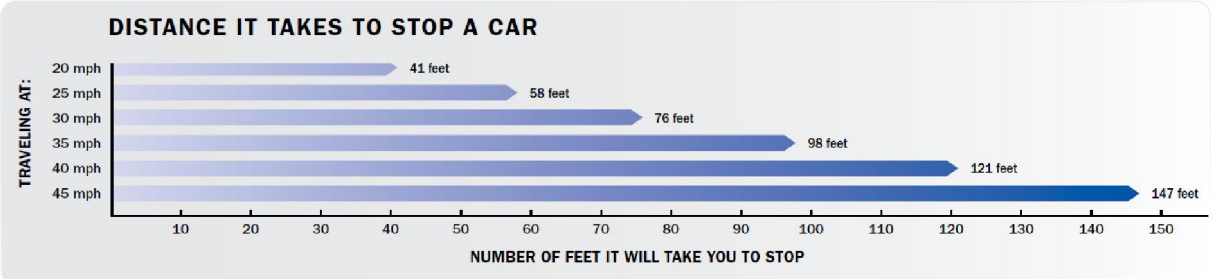

Figure 1. Travel Speed vs. Reaction and Braking. Source: Street Smarts Marin, Transportation Authority of Marin

COLLABORATIVE PLANNING

Participants in a SRTS walking and bicycling audit may identify the need for traffic calming to enhance driver compliance with existing school speed-limit zones and traffic controls (see ITE Briefing Sheets—*Walking and Bicycling Audits, Reduced School Area Speed Limits*, and *School Area Traffic Control*). Transportation professionals should work closely with SRTS committees and the neighboring community to categorize existing issues and identify potential traffic calming solutions.

Many jurisdictions have developed "toolboxes" of traffic calming measures appropriate for their school areas.[1] The toolbox provides descriptions of the various applicable traffic calming measures, as well as their potential advantages and disadvantages, and cost. When selecting appropriate measures, planners and engineers should consider potential

[1] The Institute of Transportation Engineers (ITE) Traffic Calming Library provides information and research about a range of treatments: www.ite.org/traffic/.

consequences, including diverting traffic onto other streets, impeding emergency or transit vehicles, or reducing access to private homes.

TRAFFIC CALMING MEASURES AROUND SCHOOLS

A wide range of traffic calming measures may be used alone or in combination near school zones to address vehicular speeds and/or volumes. The design of these measures should take into account how they would impact pedestrians and bicyclists, emergency response times or routing for transit vehicles, neighborhood access, drainage, and snow removal where appropriate. All measures should be properly designed, with appropriate spacing and use of signs, striping, lighting, and vertical elements where necessary to improve visibility.

The following traffic calming measures can be used to reduce travel speeds near schools:

Figure 2. Curb Extension. Source: www.pedbikeimages.org/Dan Burden

Curb extensions

Curb extensions are installed to reduce the roadway width from curb to curb at an intersection, shortening the crossing distance for pedestrians and making it easier for motorists to see pedestrians. Also known as bulbouts and neckdowns, curb extensions extend through the parking lane but should not narrow the travel lane or impede bicyclists on a bike route.

Chicanes, lateral shifts, and chokers

These all consist of road narrowings installed at non-intersection locations to create a narrow two-lane gap or a single lane. Chicanes are a type of lateral shift that requires traffic to move from side to side of the street in order to create an S-shaped travel path. Chokers are midblock curb extensions that narrow the street by expanding the sidewalk or adding a planting strip, and often are installed at midblock crossings. These features can compromise on-street parking and bus access, and may have limited application near schools.

Speed humps

Speed humps are raised sections of pavement placed across the street to force motorists to reduce speeds. While they are effective in reducing traffic speeds and are relatively low cost, speed humps may be controversial in some localities due to their appearance, and potential jarring effects on vehicles and passengers.

Speed tables and raised crosswalks

Speed tables are similar to speed humps, except they include a flat section on top, sometimes constructed with a decorative surface material. Raised crosswalks are speed tables marked as a pedestrian crossing, which allows pedestrians to cross without stepping down and up between the curb and the road. Truncated domes should be used to demarcate the transition for pedestrians with vision impairments. Speed tables permit slightly higher motorist speeds and smoother transitions than do speed humps.

Figure 3. Raised crosswalk through school parking lot. Source: Alta Planning + Design

Raised intersections

A raised intersection refers to a roadway intersection entirely elevated to sidewalk level. Raised intersections are designed with ramps for the vehicles and may include decorative surface materials on the flat, raised section. Since raised intersections are usually the same height as the sidewalk, they create a nearly seamless transition with sidewalks and crosswalks, which are demarcated with truncated domes. Issues associated with raised intersections include drainage, motorists turning across the sidewalk area at corners, and the ability to communicate the edge of the roadway to vision-impaired pedestrians.

Neighborhood traffic circles/mini traffic circles

Mini traffic circles are often located on lower-volume residential streets, where traffic is required to circulate counterclockwise around a center island, slowing entering and exiting drivers.

Approaches to neighborhood traffic circles are sometimes controlled by YIELD or STOP signs but in some cases are not controlled due to low speeds and volumes at these intersections.

Modern roundabouts

Roundabouts are a type of circular intersection defined by three basic operational principles: 1) geometry that results in a low-speed environment, 2) entering traffic yields to vehicles in the circulatory roadway, and 3) channelization at the entrance and deflection around a center island are designed to be effective in reducing conflict. Proper site selection, channelization, and design features are essential for making roundabouts accessible to all users, including student pedestrians and cyclists. Modern roundabouts are recognized by FHWA as a proven countermeasure.

Traffic calming that primarily controls traffic volume restricts certain vehicular movements. Bicycle and pedestrian access should be maintained through these measures. The following traffic calming measures can be used primarily to control traffic volumes:

Half-street closures

Half-street closures block one side of the street at an intersection so that one direction of traffic is diverted to another route. In the context of SRTS, they may be used to reduce high volumes of through traffic in the vicinity of schools or along a school route. Half-street closures are often called partial closures or one-way closures. They are constructed using the same materials and designs as full closures but may not require a turnaround. Some enforcement and neighborhood outreach may be needed to obtain neighborhood approval and promote compliance. While half-street closures provide emergency access for fire trucks and ambulances, consideration must be given to the effect they may have on school bus routing, sanitation pickup, and mail delivery routes.

Median islands

Median islands are raised islands located in the middle of a street that continue across an intersection, preventing cut-through motor vehicle traffic at a cross street. Median islands also block left-turning motorists off the main street, which reduces conflicts with pedestrians crossing the main street. Wide median islands may also serve as a pedestrian refuge, providing a safer two-stage crossing where pedestrians need to focus only on traffic coming from one direction at a time. Median islands are recognized by FHWA as a proven countermeasure.

Forced-turn islands

Forced-turn islands are also called forced-turn channelizations, pork chops, or right-turn islands. They require traffic to turn at an intersection and can prohibit drivers from turning into the side street.

ADDITIONAL RESOURCES

Traffic calming can play a key role in creating safe routes to school by reducing vehicle speeds and volumes and creating a comfortable and attractive neighborhood bicycle and pedestrian environment. The measures previously described are just a few examples of many available traffic calming tools. Numerous resources identify various traffic calming tools and their advantages, disadvantages, and cost. Examples include the following:

- National Center for Safe Routes to School: guide.saferoutesinfo.org/engineering/slowing_down_traffic.cfm
- Institute of Transportation Engineers: www.ite.org/traffic/
- Pedestrian and Bicycle Information Center: www.walkinginfo.org/engineering/calming.cfm
- Federal Highway Administration: www.fhwa.dot.gov/environment/sidewalk2/sidewalks209.htm
- Canadian Guide to Neighbourhood Traffic Calming: www.ite.org/traffic/tcstate.asp#cgntc
- U.S. Traffic Calming Manual: www.planning.org/media/trafficcalming/
- FHWA Proven Safety Countermeasures: http://safety.fhwa.dot.gov/provencountermeasures/

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