INTRODUCTION

A complete street accommodates all travel modes, supports residences and businesses and is a community asset

The Importance of Good Design and Context

Well-designed bicycle and pedestrian facilities are safe, attractive, convenient and easy to use. It is wasteful to plan, design and build facilities that are little used, or used irresponsibly because of poor design. ***Inadequate facilities discourage users and unnecessary facilities waste money and resources***.

Bicycle and pedestrian facilities must be considered at the onset of transportation projects and incorporated into the design process at all stages, so potential conflicts with other modes, topography or right-of-way constraints are resolved early on. Bikeways and walkways risk being under-designed if they are considered add-on features.

Good design does more than help those who already walk or bicycle; ODOT encourages greater use of non-motorized transportation. Examples of facilities that encourage use are:

Bike lanes provide cyclists their own space on the road. They also:

- Establish the correct position of cyclists on the road;
- Provide bicyclists room to travel at their own speed, they can pass cars backed up at intersections;
- Reduce bicycle/pedestrian conflicts as fewer cyclists ride on sidewalks; and
- Send a message to motorists that bicyclists have a right to the roadway.

Separated sidewalks create a pleasant walking environment away from traffic. They also provide:

- Room for street furniture such as signs, utility and signal poles, mailboxes and bike racks;
- An opportunity for landscaping and shade-trees, increasing the appeal of a roadway; and
- A better environment for wheelchair users, as sidewalks are level at driveways.

Context Sensitive Design

Context should always determine which type of walkway and/or bikeway to provide, and to what standard. Applying standards without regard to how a facility will function within the greater context can lead to under- or overbuilt facilities, inappropriate for the context. There are several ways of defining context; they are not mutually exclusive, and should be referred to when determining what parameters to use when providing walkways and bikeways.

1. Land uses defined in broad terms: rural, urban, suburban, and urban (or suburban) fringe. This applies in clearly defined contexts such as an urban street in an established part of a city, or a truly rural road. It is harder to define context using these terms in ambiguous situations such as a rural road in a recently annexed part of a city that is being redeveloped.

➢ Utility in selecting appropriate design criteria: Moderate

2. Land uses immediately adjacent to a street: residential, commercial, institutional, industrial, or mixed use. These can help determine what destinations may be accessible on foot or by bicycle by those using that street.

➢ Utility in selecting appropriate design criteria: Moderate/High

3. The 1999 Oregon Highway Plan has identified four types of urban highway segment designations:

- Special Transportation Areas (STA),
- Urban Business Areas (UBA),
- Commercial Centers, and
- Non-Designated Urban Highways.

The Oregon Highway Design Manual also describes categories that do not meet the requirements or intent of the other highway segment designations:

- Urban Fringe/Suburban,
- Developed, and
- Traditional Downtowns/Central Business Districts.

Definitions, applicability and policies regarding these designations can be found in the Oregon Highway Plan: *www.oregon.gov/ODOT/TD/TP/orhwyplan.shtml#1999_Oregon_Highway_Plan* and the Oregon Highway Design Manual: *www.oregon.gov/ODOT/HWY/ENGSERVICES/hwy_manuals.shtml#2003_English_Manual*

➢ Utility in selecting appropriate design criteria: Moderate/High

4. "Main Street: When a Highway Runs Through it": published by the Oregon Downtown Development Association (in cooperation with ODOT), it is designed for communities that are working together to enhance the vitality of their main street (*http://www.odda.org/content/pubs.html).*

➢ Utility in selecting appropriate design criteria: High

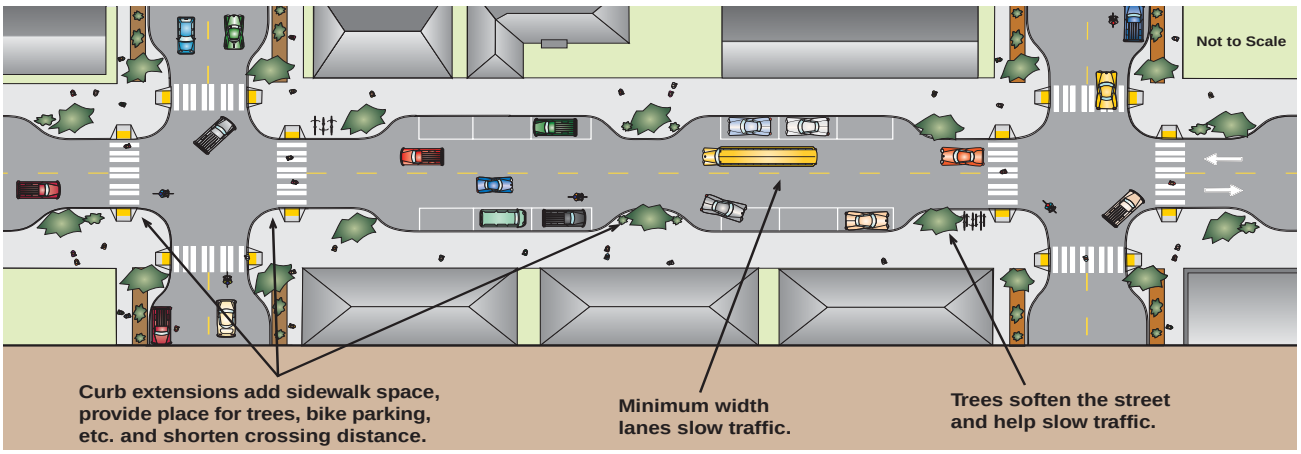

Figure I-1: Sample illustration from Main Street Handbook

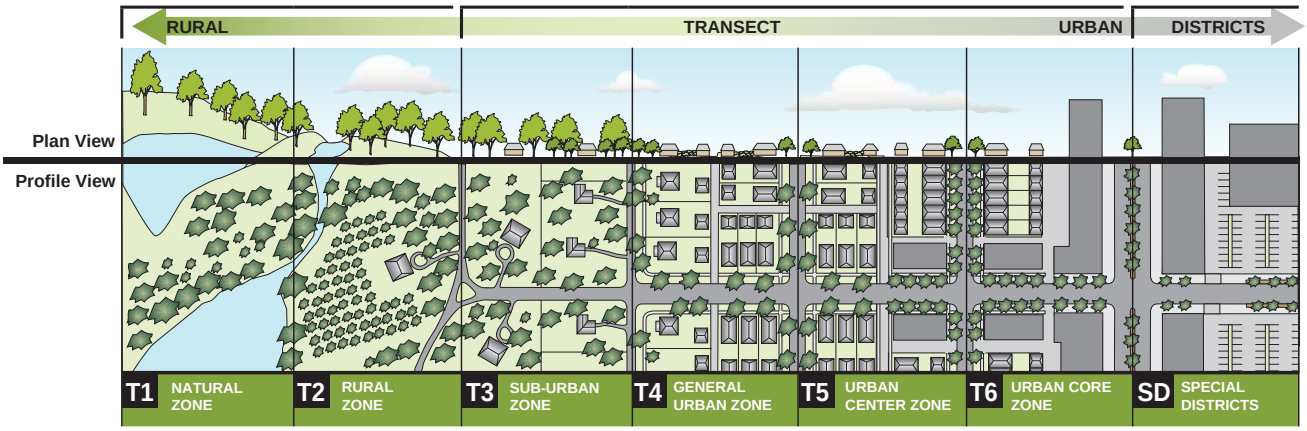

Figure I-2: The Transect (Congress of New Urbanism)

5. The Transect, a context classification created by the Congress for New Urbanism, a framework that identifies a continuous range of habitats from the most natural to the most urban; the 6 Transect Zones are:

- T-1 Natural Zone: lands approximating a wilderness condition, unsuited for settlement due to topography, hydrology or vegetation.
- T-2 Rural Zone: sparsely settled lands in open or cultivated state; woodland, agricultural, etc.
- T-3 Sub-Urban Zone: low-density suburban residential areas with deep setbacks, natural planting, long blocks and irregular roads to accommodate natural conditions.
- T-4 General Urban Zone: mixed-use but mostly residential urban with a range of building types with variable setbacks, and medium-sized blocks.
- T-5 Urban Center Zone: high density mixed-use buildings with retail, offices, rowhouses and apartments, a tight network of streets, wide sidewalks, street trees and buildings set close to the frontages.
- T-6 Urban Core Zone: the highest density, with the greatest variety of uses, and civic buildings of regional importance.
- Special Districts: areas with buildings that by their function, disposition, or configuration cannot conform to one of the Transect Zones.

➢ Utility in selecting appropriate design criteria: Very High

6. Portland Metro's regional street design concepts reflect the fact that streets perform many, often conflicting functions, and the need to reconcile conflicts among travel modes to make the transportation system safer for all modes of travel. Implementation of the design concepts is intended to promote community livability by balancing all modes of travel and address the function and character of surrounding land uses when designing streets of regional significance. The street design concepts fall into three broad classifications:

- Throughways emphasize motor vehicle and freight travel and connect major activity centers and provide inter-city, inter-regional and inter-state connections, with an emphasis on mobility.
- Boulevards in mixed-use areas (e.g. 2040 centers, station communities and main streets) integrate motor vehicles, freight, transit, bicycle and pedestrian modes of travel, with an emphasis on pedestrian, bicycle and transit travel.
- Streets in 2040 mixed-use corridors, industrial areas, employment areas and neighborhoods integrate motor vehicles, freight, transit, bicycle and pedestrian modes of travel, with an emphasis on vehicle mobility and special pedestrian infrastructure on transit streets.

- Utility in selecting appropriate design criteria: High

7. AASHTO Street (functional) Classification System: For the purposes of highway and street design, the American Association of State Highway and Transportation Officials (AASHTO) developed the functional classification system (or street hierarchy) to determine which design standards are applicable; the classifications are ***arterial, collector and local streets***. Local streets serve residences and short neighborhood trips; collectors gather traffic from the neighborhoods and channel vehicles onto arterials, which are designed for longer trips. Most commerce, institutions and other important destinations are located on arterials.

The street hierarchy is a planning tool for motor vehicle traffic, and is the basis for many of the design criteria in AASHTO. It is not always a practical design tool, as arterial, collector and local streets are found in a variety of land use contexts. The practice of standardizing typical sections for each of these classifications results in many streets that do not serve bicyclists, pedestrians or adjacent properties well. To effectively design for bicyclists and pedestrians, the context of the street must be considered; each context requires different design treatments - one size does not fit all. The design should match the context, not the street classification.

Also, pedestrians and bicyclists have their own needs; they may want to travel to major destinations using local streets, or conditions on arterials may be very intimidating to them (high traffic volumes and speeds, no sidewalks or bike lanes, buildings set far back and difficult to access on foot).

This manual proposes a more comprehensive approach, one more compatible with the needs of pedestrians and bicyclists. Terms such as thoroughfares and residential streets capture the essence of the function and the look and feel of a street from their perceptive. The Oregon Highway Plan (OHP) should be consulted for highway classification as it applies to vehicular traffic.

- Utility in selecting appropriate design criteria: Low

Regardless of which context or street classification system is used, land uses change over time, in most cases towards a denser, more urban form. Street projects are usually designed for a 20-year life (bridges 50 years or more), so planners and designers must consider how a planned roadway will function in the future. It is better to build facilities that may not be immediately needed, rather than come back later and retrofit them at great expense. But over design (a road widened to accommodate future traffic volumes but is too wide for the current conditions) may encourage speeding. To avoid this outcome, measures should be taken in the interim to slow traffic down, such as delineating the widened pavement with markings, so the roadway appears narrower.

Bicyclists and Pedestrians: Similarities & Differences

Many early bikeway designs assumed that bicyclists resemble pedestrians in their behavior. This led to undesirable situations: bicyclists are under-served by inadequate facilities, pedestrians resent bicyclists in their space, and motorists are confused by bicyclists entering and leaving the traffic stream in unpredictable ways. Only under special circumstances should bicyclists and pedestrians share the same space, e.g. on shared-use paths. The modes are similar in several ways:

Location: Bicycle and pedestrian facilities, though separate from each other, are found between the motor vehicle travel lanes and the right-of-way line, often in conflict with other demands such as utilities. This can create competition for this valuable space.

Context Sensitive Designs: Both streets serve all modes - Bicyclist on the left shares the road with traffic in an urban slow speed environment. Pedestrian on the right uses the shoulder in a rural context

Exposure: Pedestrians and bicyclists are exposed to the elements and are vulnerable in crashes.

Behavior: Pedestrians and bicyclists can be of any age and no license is required. Their actions and reactions change with age and are sometimes unpredictable.

Bicyclists and pedestrians differ in significant ways:

Bicyclists

Bicyclists operate a vehicle and are legitimate road users, but they are slower and less visible than motor vehicles; they are also more vulnerable in a crash than motorists. They need accommodation on busy, high-speed roads and at complex intersections. In congested urban areas, bicyclists can often proceed faster than motorists on well-designed facilities.

Bicyclists use their own power, must constantly maintain their balance and don't like to interrupt their momentum. They like to ride side-by-side so they can interact socially with a riding companion. Typical bicyclist speeds range from 10-15 MPH, enabling them to make trips up to 5 miles or so in urban areas in about 25 minutes; this is equivalent to a typical suburban commuter trip time.

Well-designed bicycle facilities guide cyclists to ride in a manner that conforms to the vehicle code: in the same direction as traffic, usually in a position 3 to 4 feet from the edge of the roadway or parked cars, to avoid debris, drainage grates and other potential hazards. Cyclists should be able to proceed through intersections in a direct, predictable and safe manner.

Pedestrians

Pedestrians prefer separation from traffic and are slower than bicyclists. They need extra time for crossing roadways, special consideration at intersections and traffic signals, and other improvements to enhance the walking environment. Some design details contribute to safety (illumination), some make walking more convenient (paths that provide short-cuts), and others make walking more pleasant (planting strips).

Pedestrians are the most vulnerable of road users and are often not visible to motorists. They don’t tolerate delay and out-of-direction travel, and will often take shortcuts where there is no convenient or direct access. Pedestrian facilities must be designed to meet or exceed the ADA requirements (Americans with Disabilities Act).

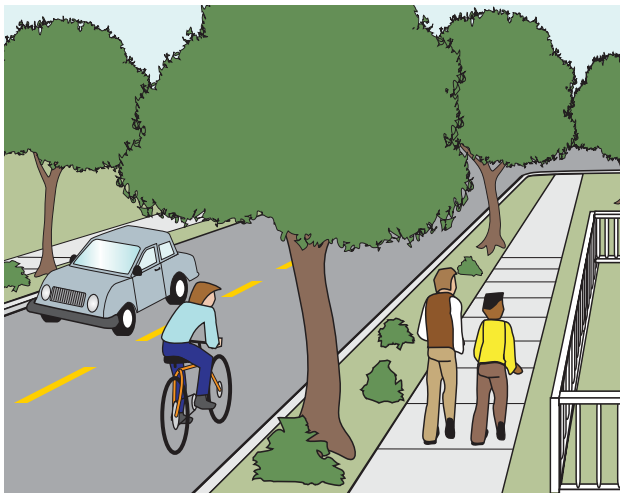

Figure I-3: Streets can be made pleasant for all users

On well-planned and well-designed streets (with buildings that abut the sidewalk), sidewalks provide mobility and also serve as direct access to destinations. Pedestrians simply walk on a sidewalk, enter a building, leave it and continue on their way, with no need for parking, a driveway or specially designed access. This underscores the importance of good urban design in creating walkable environments.

Typical walking speeds range from 2-3.5 MPH, enabling them to make trips up to a mile or so in urban areas in about 20 minutes; this is equivalent to a typical urban trip for errands.

Design Standards

The design standards and recommendations in this document are for use on Oregon highways. The previous discussion on context sensitive design should be consulted when determining which standard is applicable for the context.

ODOT encourages local agencies to use the dimensions and designs recommended in this plan; local standards may exceed ODOT standards. When ODOT is constructing a bikeway or walkway in collaboration with a local jurisdiction, the more appropriate of the two designs should be used, based on the context. On some local streets, dimensions less than those recommended in this plan may also be appropriate; for example non state highways can have very narrow motor vehicle travel lanes to accommodate bike lanes.

To establish primary design practices, ODOT has adopted the American Association of State Highway and Transportation Officials (AASHTO) guidelines. AASHTO publishes the "Guide for the Development of Bicycle Facilities," and the "Guide for the Planning, Design and Operation of Pedestrian Facilities." Most ODOT design standards are contained in the "Highway Design Manual" (HDM).

Relationship between this document, AASHTO and the HDM: This plan contains some recommendations and best practices that exceed AASHTO and/or the HDM standards. Also included in this plan are designs that ODOT has developed for situations that are not covered by AASHTO or the HDM. On state highways, the standards in the HDM must be met as a minimum; on local agency projects where funds are administered through ODOT, the AASHTO standards must be met as a minimum; on local agency projects using local funds, local agencies can adopt AASHTO or the practices recommended in this manual.

Relationship between this document and ADA: All ODOT walkway design standards meet or exceed the minimums set by the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the proposed Public Right-of-Way Accessibility Guidelines (PROWAG).

Relationship between this document and the MUTCD: Traffic control devices must conform to the "Manual on Uniform Traffic Control Devices" (MUTCD) as supplemented and adopted by the Oregon Transportation Commission. Oregon has developed signing and striping standards for ODOT highways; these are also recommended practices for all Oregon roads. They are contained in the ODOT Traffic Line Manual, the ODOT Sign Policy, and ODOT standard drawings. All

signing and striping plans should be reviewed by a traffic engineer.

Relationship between this document, local plans and Transportation System Plans: Designers should consult adopted local TSP's to ensure designs are consistent with local adopted and acknowledged plans and standards; otherwise a local plan amendment is needed.

Note: *Some dimensions referenced in this document (for example travel lane width in relation to bike lane restriping in chapter 2) are for illustration purposes only, and should not be used as roadway design standards.*

Standards & Minimums

The standards recommended in this manual are best practices; they have been developed to create optimal conditions for most users under most conditions. Whenever possible and appropriate, facilities should be built to standard.

There are situations where standards cannot be met due to geometric or environmental constraints, or may not be appropriate, due to the context. In these circumstances, a reduced dimension may be acceptable; for every standard dimension a minimum is provided. Use of a minimum dimension should be mitigated with other design controls. However, dimensions should not be reduced to the extent that safety and usability are compromised. ODOT and many local agencies have developed processes to be followed when standards can't be met (usually a design exception or concurrence process).

There is always a range between the standard and the minimum, so intermediate values may be used. For example, the standard width for a sidewalk is 6 feet, with a minimum of 5 feet; sidewalks may also be 5.5 feet wide, depending on circumstances. In some circumstances dimensions greater than the standard are appropriate, such as on high-use sidewalks or shared-use paths.

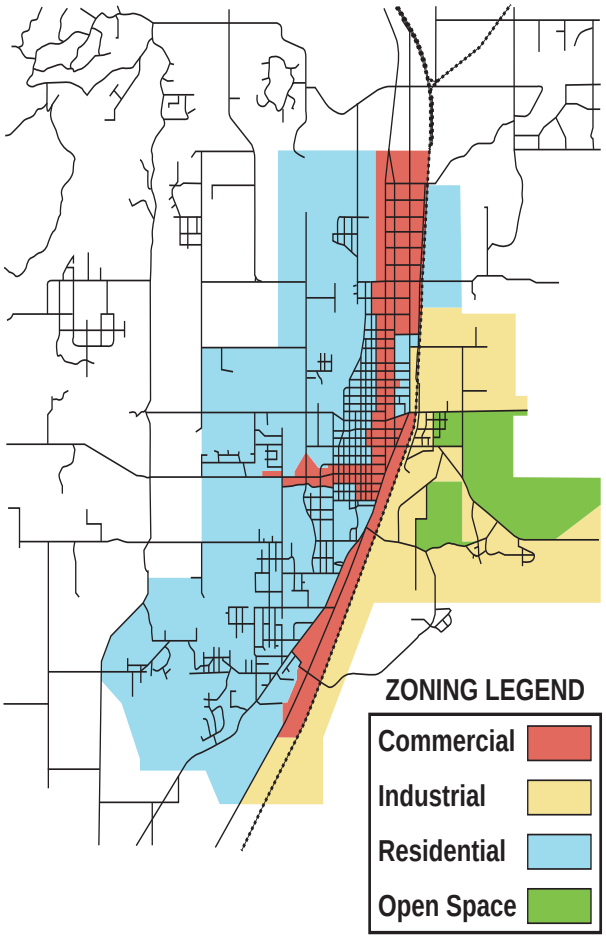

Figure I-4: Segregated land uses increase travel distances

Innovative Designs

There are many innovative designs that facilitate bicycling and walking that are not yet found in existing design manuals. This plan presents ideas that have been implemented successfully in Oregon or elsewhere, to enhance the roadway environment for bicyclists and pedestrians, or to lessen the negative impacts of designs created to improve motor-vehicle flow. These practices are preceded with the following paragraph:

> *"These concepts are presented as information, to help ODOT, cities and counties to come up with new solutions to common problems."*

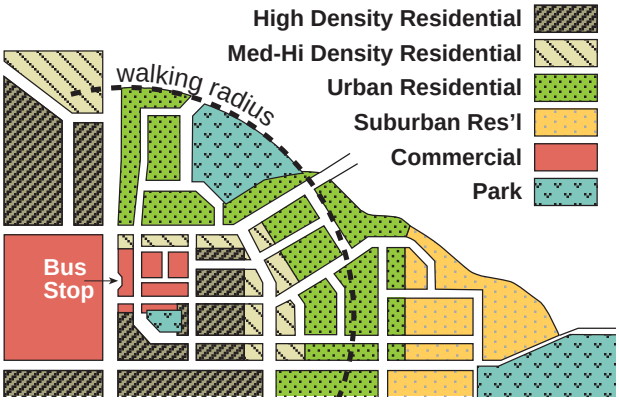

Figure I-5: Mixed land use fosters walking and bicycling

Planning Issues that impact walkway and bikeway design:

Land Use and Site Design

The ease of bicycling and walking is often determined by land use patterns. Most development patterns built since World War 2 create situations where an automobile is required for most trips, because:

- Segregated land uses increase the distance between origin and destination points;
- Destinations are designed to be readily accessible by automobile with buildings set far back, separated from the roadway with parking; and
- The resulting high traffic volumes and speeds on many streets discourage bicycling and walking.

Fast food with direct pedestrian access

Land use and site design patterns conducive to bicycling and walking include:

- **Greater densities,** so more residents live closer to neighborhood destinations such as stores, employment and schools;
- **Mixed-use zoning,** so destinations are closer to residential areas, making it easier to access these facilities on foot or by bicycle;
- **Multiple-use zoning,** where residences and businesses share the same structure, further reducing travel demand;
- **Locating buildings close to the street,** (ideally at the back of sidewalk) for easy access by pedestrians, and to create a sense of enclosure and comfort; and
- **A pleasant environment,** with landscaping, streetscaping and interesting building facades.

Integrating land-use and transportation planning enables new developments to implement these strategies from the onset. Communities planned to support balanced transportation make walking, bicycling and public transit attractive options.

In established communities, many of these goals can be met with in-fill development to increase density, changing zoning laws to allow mixed-use development, changing building codes and site-designs to be more accessible on foot or by bicycle, and building bicycle and pedestrian connections into and through existing, auto-oriented land uses.

Interconnected Streets

Street patterns with cul-de-sac require a long circuitous route to cover what could be a short distance, increasing out-of-direction travel for what would otherwise be a fairly short bicycle or walking trip. Disconnected streets also result in many short driving trips being made on thoroughfares adjacent to neighborhoods, unnecessarily increasing traffic volumes on these streets, and further degrading conditions for walking and biking.

Interconnected streets offer direct routes with minimal out-of-direction travel; they also allow local trips to be made using a variety of routes, lessening the burden on adjacent thoroughfares. This creates an inherently walkable and bikeable street system.

Discontinuous streets should be linked with through streets or paths. Where the right-of-way is insufficient for a street, or where cul-de-sac are incorporated into a development, paths can be provided for bicycle and pedestrian access.

Retrofitting path connections between neighborhoods can be difficult if adjacent property owners object. Often connections become available when a street is abandoned. A 20 feet easement or right-of way can be established before the street right-of-way is vacated.

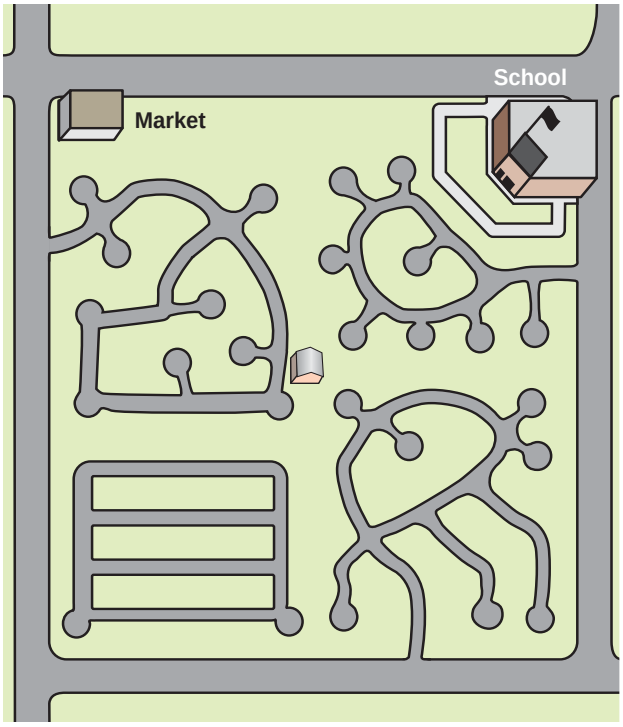

Figure I-6: Disconnected streets increase travel distances

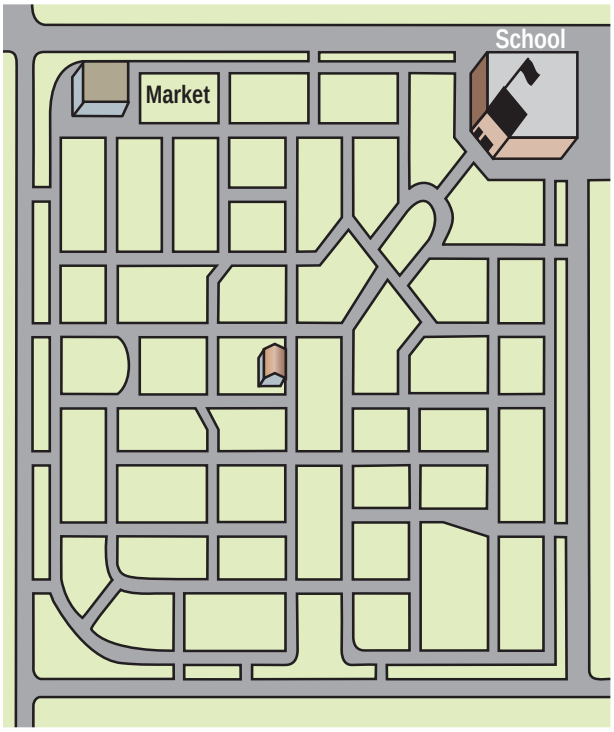

Figure I-7: Connected streets reduce travel distances, reduce traffic and increase mode choices

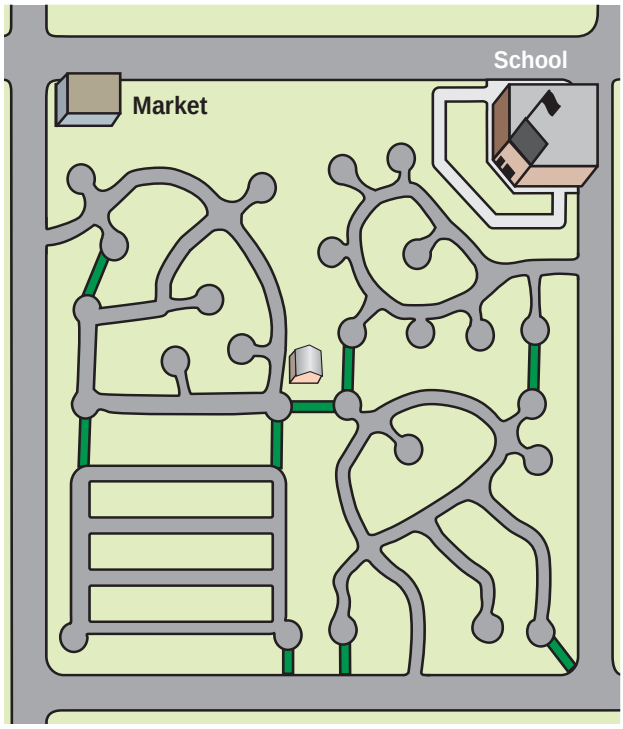

Figure I-8: Discontinuous streets linked with paths

Access Management (AM)

Unlimited accesses increase conflict points

Problems with Uncontrolled Access

Busy urban thoroughfares are often perceived as undesirable for non-motorized travel because of high motor vehicle traffic volumes. Yet conflicts rarely occur with users traveling in the same direction; most conflicts occur at intersections, driveways and alleys. Multiple accesses create conflicts between motor vehicles entering or leaving a roadway and bicyclists and pedestrians riding or walking along the roadway. Pedestrians crossing a roadway require gaps in traffic, but with unlimited access, vehicles entering the roadway quickly fill available gaps. Bicyclists and pedestrians are vulnerable if motorists fail to see or yield to them.

Benefits of AM to Bicyclists & Pedestrians

The three basic access management techniques (limiting and consolidating driveways, providing raised medians, creating frontage roads) can benefit bicyclists and pedestrians in several ways:

- The number of conflict points is reduced; this is best achieved by replacing a center-turn lane with a raised median, as left turns

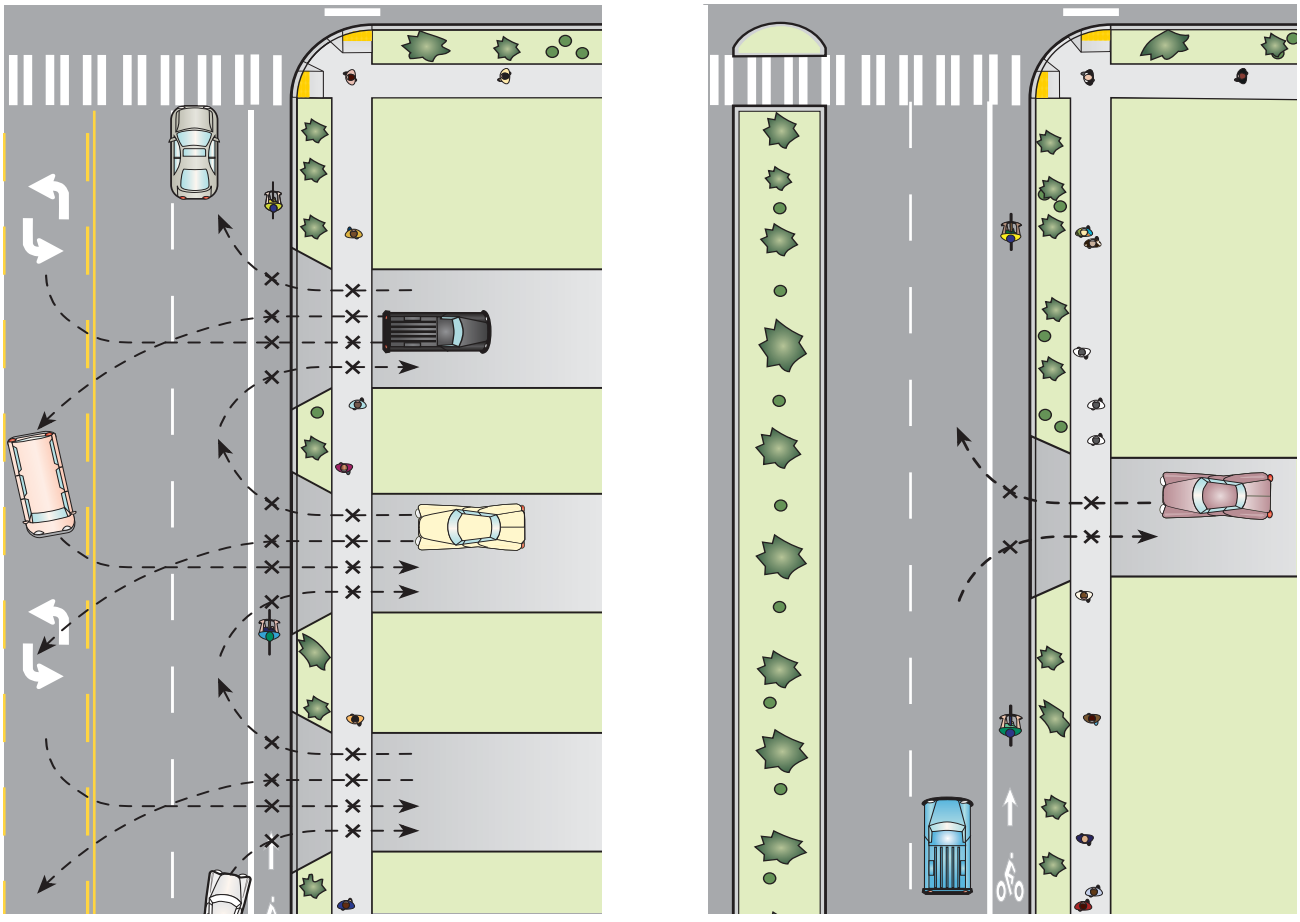

Figure I-9: Consolidating accesses reduces conflict points, benefitting pedestrians, bicyclists and drivers.

account for a high number of crashes for all users (drivers, bicyclists and pedestrians);

- Motor vehicles are redirected to intersections with appropriate control devices;
- Pedestrian crossing opportunities are enhanced with a raised median and fewer conflicts with turning cars;
- ADA compliance is easier, as the need for special treatments at every driveway is reduced; and
- Improved traffic flow may reduce the need for road-widening, allowing part of the right-of-way to be recaptured for bicyclists, pedestrians and other users.

While new roads can be designed using these principles, it is more difficult to retroactively reduce, consolidate or eliminate existing accesses. Yet this is an important strategy to make existing roads more attractive to bicyclists and pedestrians.

AM Outcomes That Hinder Walking and Bicycling

The following issues must be considered and addressed when implementing access management:

- Streamlining a thoroughfare may increase traffic speeds and volumes;
- Reduced access to businesses may require out-of-direction travel, discouraging walking and bicycling; and
- Improperly designed raised medians act as barriers: pedestrians should be able to see to the other side of the street (vegetation should not decrease visibility) and curbs should be no more than standard height. Concrete barriers and tubular markers, for example, completely prohibit crossings.

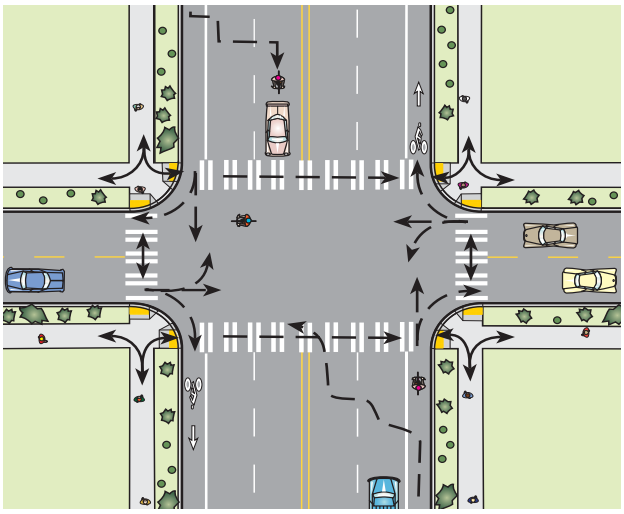

Figure I-10: Allowable movements at an intersection

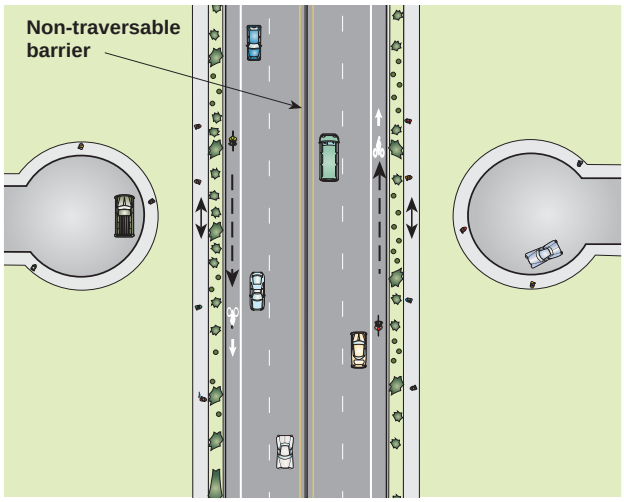

Figure I-11: Severed connection eliminates conflicts.

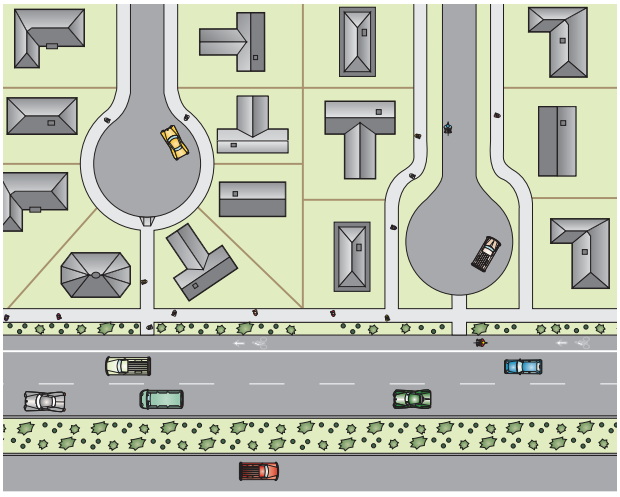

Figure I-12: Pedestrian and bicycle connections can be preserved

AM and Street Connectivity

Limiting the number of street connections has a negative impact on walking and bicycling, as eliminating local street intersections eliminates pedestrian crossing opportunities, reduces pedestrian and bicycle travel choices, and increases out-of-direction travel. Wherever possible connections should be reestablished with pathways.

Where limited access thoroughfares exist in urban areas, safe and frequent grade-separated crossings should be provided, and parallel local streets should be improved for bicycle and pedestrian circulation.

Public Transit

Transit trips begin and end with a walk or bike ride. Pedestrian and bicycle facilities in transit corridors make transit systems more effective. Therefore, high priority should be given to providing sidewalks and bikeways on transit routes and on local streets feeding these routes.

Transit users need to cross the road safely at stops: on a street with residences and/or development on both sides, half the riders will need to cross a road when boarding or exiting a bus. Since there is an element of risk in crossing busy streets, crossing safety should be a primary consideration at transit stops. The safety of pedestrians can also be enhanced by consolidating, relocating or eliminating stops. These transit operation improvements are usually implemented by the transit agency in cooperation with the road authority.

Access to transit also involves selecting the right location for stops, especially for bus stops located on surface streets. Choosing transit stop locations for buses, light rail and Bus Rapid Transit is a complicated task, as each location must take into account three factors:

- **Passengers**: stops must be near places where there's an expectation of riders;
- **Access**: if a stop can't be located right where riders are, they must be able to get to the stop conveniently; and
- **Traffic characteristics**: buses can't always stop where riders want to be because of complex traffic patterns, especially at intersections.

Convenient access by passengers must remain at the forefront of all transit stop planning: simply eliminating stops because they are perceived as unsafe will not be satisfactory to riders who cannot walk very far. Better approaches are to make access and crossing improvements at existing stops that serve passengers well, or to relocate them to a safer and more accessible location within a reasonable walk.

Bus stops should provide a pleasant environment for waiting passengers, with shelters, landscaping, adequate buffering from the road and lighting. Bus stop design should minimize conflicts with other non-motorized users, such as bicyclists on bike lanes or pedestrians walking past passengers waiting to board.

Bus stops should be placed in locations that are readily accessible by pedestrians, or that can be made accessible by changing the configuration of adjacent land use. This can be done by:

- Orienting building entrances to the transit stop or station;
- Clustering buildings around transit stops; and
- Locating businesses close to transit stops.

Regional and statewide public transportation systems benefit from bicycle facilities such as:

- Accommodating bicycles on buses and trains;
- Bikeways leading to stations, transit centers and park-and-ride lots; and
- Providing secure bicycle parking at these locations.

Well planned and situated bus stop