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"Efficiency - Equity - Clarity"

Pedestrian and Bicycle Planning

A Guide to Best Practices

14 August, 2016

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Abstract

This guide covers all aspects of pedestrian and bicycle planning. It is intended for policy makers, planners and advocates who want the best current information on ways to make their communities better places for walking and cycling. It provides basic information on various planning and design concepts, and offers extensive references to help implement them. It describes general nonmotorized planning practices, how to measure and predict nonmotorized travel, how to evaluate and prioritize projects, and how to implement various programs that support nonmotorized transportation. It covers planning for paths, sidewalks, bikelanes, street improvements, road and path maintenance, road safety, personal security, universal access (including features to accommodate people with disabilities), nonmotorized traffic law enforcement, education and encouragement programs, and integration with a community's strategic plans and various other programs. There are also appendices that provide more detailed information on planning, design and evaluation.

This is an ongoing project. We welcome your feedback.

Foreword

Transport planning practices must change if they are to incorporate nonmotorized modes. While walking and cycling have long been recognized as important activities, mobility and access as measured in traditional planning practices focused on motor vehicle travel. There is increasing recognition that balanced transportation choices are important to individual travelers and society overall. This guide presents best practices for nonmotorized transport planning.

Planning for nonmotorized travel can benefit your community in many ways. It can remove barriers to mobility and increase the safety and comfort of pedestrians and cyclists, broaden travel options for non-drivers, reduce conflicts between motorists and other road users, reduce automobile traffic and the problems it creates, increase recreational activity and exercise, encourage nonmotorized tourism, better accommodate people with disabilities, and help create more livable communities. Improved pedestrian and cycling conditions can benefit everybody in your community regardless of how much they use nonmotorized travel modes.

This guide describes how to develop local pedestrian and bicycle plans. It discusses reasons that communities should develop such plans, provides specific instructions for developing your planning process and creating your plan, discusses how to integrate nonmotorized planning into other local planning activities, and provides an extensive list of pedestrian and bicycle planning resources. This guide describes how to use available resources most efficiently to improve walking and cycling conditions in your community.

A pedestrian and cycling plan is not just a map showing paths and trails. It can address a variety of issues including:

1. Coordination of nonmotorized transportation improvements with other community plans.
2. Encouraging nonmotorized transport for transportation and recreation.
3. Nonmotorized safety education programs.
4. Traffic management and traffic calming.
5. Improving enforcement of traffic laws related to nonmotorized travel.
6. Pedestrian and bicycle facility planning and design.

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I. Introduction: Why Plan for Walking and Cycling

There are many reasons to plan for nonmotorized transportation. Walking, cycling, jogging and skating[1] are increasingly popular for transport and recreation. Safe and convenient nonmotorized travel provides a many benefits, including reduced traffic congestion, user savings, road and parking facility savings, economic development and a better environment. This section presents a brief overview of the importance of considering nonmotorized transport in transport plans.

The ultimate goal of transportation is to provide access to goods, services and activities. In general, the more transportation options available, the better the access. Nonmotorized modes are important transport choices, for trips made entirely by walking or cycling, and to support public transport. In urban areas, walking and cycling are often the fastest and most efficient way to perform short trips. A built environment that is hostile to non-motorized transport reduces everybody's travel choices. The result of this "automobile dependency" is increased traffic congestion, higher road and parking facility costs, increased consumer costs, and greater environmental degradation. Adequate pedestrian and cycling conditions are essential to guarantee everybody a minimal level of mobility ("basic mobility"). As stated in one of the primary roadway design guides,

> Pedestrians are a part of every roadway environment, and attention must be paid to their presence in rural as well as urban areas…Because of the demands of vehicular traffic in congested urban areas, it is often extremely difficult to make adequate provisions for pedestrians. Yet this must be done, because pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas. In general, the most successful shopping sections are those that provide the most comfort and pleasure for pedestrians.[2]

Walking, cycling and skating are enjoyable and healthy activities. They are among the most popular forms of recreation. Public health officials increasingly recognize the importance of frequent aerobic exercise.[3] According to a government report, "*Regular walking and cycling are the only realistic way that the population as a whole can get the daily half hour of moderate exercise which is the minimum level needed to keep reasonably fit*."[4]

Nonmotorized travel can contribute to the local economy by supporting tourism and quality development. Pedestrian-friendly conditions improve the commercial and cultural vibrancy of communities. Increased pedestrian traffic helps create a safer and more pleasant environment. Once visitors arrive in a community they often explore it by walking, cycling and skating. A good walking environment can enhance visitors' experience. Some trail networks are destination tourist attractions, bringing hundreds or thousands of visitors, and thousands or millions of dollars annually to a community.

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[1] J. Scott Osberg, Stephanie Faul, Joshua Poole, and John McHenry, *Skating: An Emerging Mode of Transportation*. Transportation Research Board Annual Meeting, 2000.

[2] *Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials, 1994, p. 97.

[3] *Physical Activity and Health: A Report of the Surgeon General*, Center for Disease Control (www.cdc.gov/nccdphp/sgr), 1996.

[4] Physical Activity Task Force, *More People, More Active, More Often*, UK Department of Health (London), 1995, cited in Judith Hanna, "Transport and Health: Fit to Get About" *Urban Transport International*, No. 4, March/April 1996, p. 11.

When your community implements pedestrian and cycling improvements, it is important to do it correctly. Excellent planning resources are now available to help plan, evaluate, construct and maintain nonmotorized facilities. There is no need to reinvent the wheel, and no excuse for employing inadequate or outdated methods. Good planning is far cheaper than correcting mistakes later.

Many communities have provided relatively little support to nonmotorized travel. As described later in this guide, methods commonly used to evaluate roadway projects tend to favor motorized travel and overlook the benefits of improved nonmotorized access, so pedestrian and cycling programs tend to be underfunded. As a result, many areas have inadequate sidewalks and crosswalks, roads are not designed or maintained to accommodate cycling, and opportunities for pedestrian and cycling facilities and connections are overlooked.

Virtually all communities that have increased nonmotorized transport have achieved this by improvements to their walking and cycling environment. Walking and cycling facilities can pay for themselves through road and parking facility savings. For example, a bicycle improvement that shifts 100 trips a day from driving to bicycling can provide as much as $1 million in parking and roadway cost savings over its lifetime.

Few improvements will be implemented without a plan. Good planning can reduce the cost of improvements by allowing, for example, nonmotorized improvements to be incorporated into scheduled road projects. Funding is often available for nonmotorized projects and programs. Obtaining this support requires that a community have a plan that identifies and prioritizes projects and programs. It is therefore important for local governments to develop plans to be ready for opportunities that may arise.

Planning Tip

Summary of Nonmotorized Transportation Benefits[5]

Personal Benefits

- Mobility, particularly important for non-drivers (including children and the elderly).
- Financial savings.
- Exercise, leading to increased health and well being (reduced heart disease, stroke, hypertension, obesity, diabetes, colon cancer, osteoporosis, stress, and depression).
- Increased social interaction, opportunities to meet neighbors.
- Enjoyment.

Community Benefits of Substituting Walking and Cycling for Short Car Trips

- Reduced traffic congestion.
- Road and parking facility savings.
- Reduced motor vehicle air, water, and noise pollution.
- Improved public health.
- More livable communities.
- Increased community interaction, which can result in safer streets.
- Increased appeal and access for tourists.
- More efficient land use (reduced sprawl), by encouraging infill development.

[5] Todd Litman, *Quantifying the Benefits of Nonmotorized Transport*, VTPI (www.vtpi.org), 1999.

II. Transport Planning Overview

1. Planning Process

Any planning should be based on an overall *problem statement, vision,* and general *goals*. The vision and goals help determine specific *objectives*. This also determines the *evaluation criteria* that will be used for prioritizing *actions, programs, projects,* and *tasks*.

Problem Statement, Vision, and Goals
(*examples:* safety, health, mobility, equity, economic development)
⇓
Objectives
(*examples:* teach safety, improve roadway and trail facilities, increased nonmotorized travel)
⇓
Evaluation Criteria
(*examples:* crash/injury rates, Bicycle Compatibility Index, nonmotorized travel rate)
⇓
Actions, Programs, Projects, and Tasks
(*examples:* adopt design standards, provide safety program, implement road and trail projects)

An effective planning process involves various stakeholders, including staff from other related agencies, potential users, and other groups who may be impacted by the plan. This process can provide long-term benefits and support the plan's implementation by educating officials and community members about pedestrian and cycling issues, establishing communication between technical staff and users, addressing potential conflicts, and creating an on-going framework for pedestrian and cycling planning. Below is a list of typical steps in a planning process.

Typical steps in a planning process:

1. Establish problem statement.*
2. Scoping and background research.
3. Develop planning process.
4. Establish vision, goals, objectives, and evaluation criteria.*
5. Identify constraints and opportunities.*
6. Prioritize projects and programs.*
7. Develop implementation plan and budget.
8. Program evaluation.
9. Update and modify plan as needed.*

*** Requires public involvement**

Coordination With Other Planning Activities

Nonmotorized planning requires coordination among various municipal and regional planning activities. Table 1 shows some of these relationships. When developing a planning process, other appropriate agencies should be consulted. For example, transportation agencies should be contacted early in the planning process, invited to participate in technical committees, consulted concerning issues that affect provincial highways, and have a chance to review draft plans.

In general, pedestrian improvements are planned at the neighborhood level, since that is the scale of most walking trips. Pedestrian improvements tend to be centered around focal points such as schools, residential, commercial, and high-density areas. Because cyclists travel farther, bicycle planning requires more coordination between jurisdictions to create an effective regional bicycle network. Grants may be available to fund some local planning activities and special projects.

Table 1 **Activities To Be Coordinated With NMT Planning**

Type of Planning	Examples
Community "strategic," "comprehensive," and "sustainability" planning.	Include nonmotorized transportation and pedestrian/bicycle friendly development strategies as a component of community strategic and comprehensive plans. Use nonmotorized transport to help achieve sustainability objectives.
Regional and local transportation	Ensure that pedestrian and cycling facilities integrate with regional facilities and attractions, including roadway construction and reconstruction, transportation terminals, transportation demand management, and transit planning.
Neighborhood plans	Ensure that neighborhood traffic management projects include sidewalks, bicycle routes, and traffic calming and traffic safety features that benefit walking and cycling.
Municipal and zoning bylaws	Ensure that zoning laws incorporate suitable sidewalk and bicycle parking requirements.
Street and new subdivision design standards	Develop pedestrian and cycle friendly street designs. Incorporate paths and connecting links when possible. Locate public services, such as schools, colleges and, local shops, within easy bicycling and walking of residences.
Land preservation	Incorporate trail and public greenspace development when planning land use and agricultural and other land preservation.
Traffic enforcement	Establish bicycle traffic law enforcement polices and pedestrian safety programs.
Economic development	Provide suitable pedestrian and cycling facilities to tourist attractions. Create trails that are tourist attractions and seek to provide public transit access to the trails and other tourist attractions.
Parks	Develop walking and cycling routes to public parks. Look for opportunities where parks can be included in walking and cycling networks.
Schools	Perform pedestrian and cycling audits around schools. Identify funding sources to improve pedestrian and cycling access to schools and related destinations. Encourage safe route to school programs.

This table illustrates examples of other community planning activities that could be coordinated with pedestrian and bicycle planning.

Public Involvement
Public involvement is an important component of nonmotorized planning. It broadens the scope of concerns, solutions, and perspectives to be considered in the plan, and can help identify potential problems early in the process. It can also help gain support for the plan's implementation.

Public Involvement Techniques[6]

- Advisory committee
- Audio-visual presentation
- Discussion paper
- News release, brochure and mail-out
- Open house (public information drop-in)
- Public meeting
- Site tour
- Small group meeting
- Survey and questionnaire
- Public workshop

Resources

Planning and Public Involvement

Desmond Connor, *Constructive Citizen Participation: A Resource Book*, Connor Development Services (www.connor.bc.ca/connor), 1997, 232 pages.

Innovations in Public Involvement for Transportation Planning, Federal Highway Administration, (Washington DC), 1994.

2. Scoping and Background Research

Scoping involves identifying the range of issues to be considered in the planning process. It is important to do this early. For example, it would be inefficient if a year into the process you discovered that your pedestrian plan should have incorporated Universal Design (accommodating the widest range of users, including people with various physical limitations) or integration with public transit service. It may be helpful to prepare a background report that provides an overview of pedestrian and bicycle planning issues. It could include available information on:

1. Existing bicycle and pedestrian infrastructure and programming.
2. Area demographics.
3. Bicycle and pedestrian collision statistics.
4. Travel surveys, pedestrian/cycling questionnaires.
5. Information on stakeholders (i.e., cycling groups).
6. Nonmotorized planning and facility development resources.
7. Current and developing planning documents.
8. Existing design and engineering standards.
9. Existing safety education and enforcement programs.
10. Known or proposed road, site, park, or trail projects affecting walking and cycling.

6 *Manual of Socioeconomic Procedures*, BC Ministry of Transportation and Highways (Victoria), 1994, Chapter 10.

3. Measuring Current Nonmotorized Travel[7]

Some nonmotorized travel data may be available from existing travel surveys and traffic counts.[8] However, most travel surveys and traffic counts under-record nonmotorized trips. Many exclude walking trips altogether, and they often undercount short trips, non-work trips, travel by children, and recreational trips. Automatic traffic counters may not record nonmotorized travelers, and manual counters are usually located on arterial streets that are less heavily used by cyclists than adjacent lower traffic streets. In fact, most trips involve nonmotorized links. For example, trips classified as "auto" or "transit" trips are often actually "walk-auto-walk," or "bike-bus-walk" trips, yet the nonmotorized components are often ignored, even if they occur on public roads.

One study finds that the actual number of nonmotorized trips is six times greater than what conventional surveys indicate.[9] In 2000, the Southern California Metropolitan Transportation Authority increased the portion of nonmotorized travel in their models from about 2% of regional trips (based on conventional travel surveys) up to about 10% (based on more comprehensive travel data from the 1995 National Personal Transportation Survey).

Information on current walking and cycling travel can be gathered using:

1. A general travel survey designed to elicit sufficient responses concerning nonmotorized travel. For example, "travel" should be clearly defined to include walking and bicycling trips. Short, non-work and recreational trips, and trips by children should be counted.
2. A special survey targeting cyclists and pedestrians (such as survey forms distributed through bicycle shops, sport clubs, recreation centres, colleges, and schools).
3. A survey handed out to cyclists and pedestrians as they travel along a street or path.
4. Traffic counts that gather information on pedestrian and bicycle travel. These can include photoelectric counters installed on trails, electronic counters installed on cycle paths and bike lanes, and manual counts. Volunteers from pedestrian and cycling organizations may also be mobilized to perform manual counts for nonmotorized travel.

Pedestrian and bicycle travel surveys should attempt to gather the following information:

- *Who* – Demographic information such as age, gender, residence location, employment status, and income.
- *Where* – Origin and destination of trips, including links by other modes (such as transit).
- *When* – Time, day of the week, day of the year, and conditions, such as weather, road conditions, and traffic conditions.
- *Why* – Purpose of trip. What factors affected travel choice (for example, would a cyclist have chosen another route or mode if road conditions or facilities were different).

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[7] See Appendix 3 for more information on evaluation techniques.

[8] BTS, *Bicycle and Pedestrian Data: Sources, Needs & Gaps*, USDOT (www.bts.gov/programs/transtu/bikeped/report.pdf), 2000

[9] Piet Rietveld, "Nonmotorized Modes in Transport Systems: A Multimodal Chain Perspective for The Netherlands," *Transportation Research D*, Vo. 5, No. 1, Jan. 2000, pp. 31-36.

Example

Nonmotorized Transport Survey Questions[10]

1. Are your neighbourhoods designed to promote walking and cycling to get to school, work, recreation, transit, and retail outlets? Are these facilities used?
2. If these facilities are not used, what improvements might be made to make them more accessible?
3. Is street lighting adequate?
4. Are sidewalks maintained, repaired, and cleared of snow in the winter?
5. Are bike lanes part of the roads?
6. Does your community master plan include facilities for cycling and walking?
7. Are there cycling organizations in your community promoting the use of bicycles?
8. Are there bicycle racks at transit stations and outside municipal facilities?
9. Do school organizations promote walking, cycling, and safety programs for both?
10. Do schools and workplaces provide secure bicycle parking?
11. Are local government officials aware of the walking and cycling needs of neighbourhoods?
12. What measures could be taken to calm traffic in your residential neighbourhoods?
13. Can community groups be encouraged to organize bicycle safety workshops?
14. Do local businesses support walking and cycling to their stores?
15. What groups might be involved in forming partnerships to promote active transportation in your community?
16. Are residents in your community encouraged to keep sidewalks clear of snow for those who want to walk?
17. Is there bicycle parking near shopping areas and other destinations?

Pedestrian and bicycle collision data can help identify barriers and hazards to nonmotorized travel. Locations with frequent pedestrian or cycling crashes indicate some combination of high risk or heavy use, both of which can justify facility improvements. Pedestrian and cycling collisions tend to be underreported, so a variety of data collection methods may be needed.[11]

If possible, travel data should be recorded in a format that can be Geographic Information Systems (GIS) coded. Since nonmotorized trips tend to be short, fine-grained mapping is important. Most traffic models use zones that are too large to capture such trips and maps that are too large to illustrate all pedestrian and cycling facilities. However, conventional traffic models can be modified to predict nonmotorized travel.[12]

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[10] *Developing Communities for Active Transportation*, Go For Green (www.goforgreen.ca), 1998.

[11] Helen James, "Under-reporting of Road Traffic Collisions," *Traffic Eng+Con*, Dec. 1991, pp. 574-583.

[12] Ronald Eash, "Destination and Mode Choice Models for Nonmotorized Travel," *Transportation Research Record 1674*, 1999, pp. 1-8.

4. Predicting Potential Nonmotorized Travel

A number of specific factors can affect demand for nonmotorized transport in a particular situation.[13] These include:

- *Attractions.* Certain activity centres tend to be major attractors for walking and cycling, including commercial districts, school-college-university campuses, employment centres, recreation centres and parks.
- *Trip distance.* Most walking trips are less than 2 kilometres and most bicycling trips less than 5 kilometres in length, although recreational trips are often much longer.
- *Demographics.* Young (10-20 years), elderly, and low-income people tend to rely more on walking for transport. Young and low-income people tend to rely on cycling for transport.
- *Land use patterns (density and mix).* Walking and bicycling for transportation tend to increase with density (i.e., number of residents and businesses in a given area) because higher density makes these modes more efficient.
- *Travel conditions.* Wide roads with heavy, high-speed vehicle traffic can form significant barriers to nonmotorized travel. Special facilities for nonmotorized travel (sidewalks, wide curb lanes, and paths) and their condition can have a significant impact on the amount of walking and bicycling that occurs.
- *Topography and climate.* These factors can affect walking and bicycling, but not as much as might be expected. For example, the cities of Seattle, Portland and Missoula report significantly higher levels of cycle transportation than many "Sunbelt" cities that are flat and have mild climates.
- *Community attitudes.* Local attitudes can have a major impact on the level of cycling in a community. For example, it may be unremarkable that cycling tends to be high among college students and staff, but many college towns find that cycling is also relatively common among people who have not formal affiliation with the college simply because it has become an acceptable form of transportation. This indicates that some people hesitate to cycle, but will if they perceive it to be more socially acceptable.
- *Time and geographic scope.* It may take several years for a community to fully achieve its full nonmotorized travel potential. First year impacts are frequently modest, but tend to increase as individuals become more accustomed to nonmotorized travel and as additional support facilities (pedestrian and bicycle network, bicycle parking, etc.) develop.

Computer modeling improvements allow better prediction of how planning decisions are likely to affect nonmotorized travel.[14] However, these are currently in the development stage and may not be cost effective for application in every community during the foreseeable future.

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[13] W.L. Schwartz, et al., *Guidebook on Methods to Estimate Nonmotorized Travel: Overview of Methods*, Turner-Fairbank Highway Research Center, FHWA (www.tfhrc.gov), 1999.

[14] Cambridge Systematics and Bicycle Federation of America, *Guidebook on Methods to Estimate Non-Motorized Travel*, FHWA, Publication No. FHWA-RD-98-166 (available at www.tfhrc.gov), 1999; PBQD, *Data Collection and Modeling Requirements for Assessing Transportation Impacts of Micro-Scale Design*, Transportation Model Improvement Program, USDOT (www.bts.gov/tmip), 2000.

Table 2 **Areas Likely to Benefit from Nonmotorized Facilities**

Feature	Examples
Favorable Demographics	Large numbers of children and young adults. A significant portion of residents who are non-drivers. Interest in fitness.
Compatible Land Use	Medium to high population density Mixed land uses. Presence of cycling generators (e.g. university)
Reasonable Trip Distances and Times	Jobs/schools within 30 minutes by walking or cycling. Shopping/services within 10-15 minutes by walking/cycling. Most destinations within 10 km.
Supportive Social Environment	Perception of safety. Presence of people activity. Employer support/tolerance of cycle commuting.
Functional Infrastructure	Basic road system adequate for cycling. No major barriers. Reasonable topography.
Suitable Traffic Conditions	Speeds/volumes reasonable. Lack of heavy commercial traffic.

Many communities have significant latent demand for nonmotorized travel. That is, people would walk and bicycle more frequently if they had suitable facilities and resources.[15] A U.S. survey found that 17% of adults claim they would sometimes bicycle commute if secure storage and changing facilities were available, 18% would if employers offered financial incentives, and 20% would if they had safer cycling facilities.[16] Table 3 summarizes a recent Canadian public survey indicating high levels of interest in cycling and walking.

Table 3 **Active Transportation Survey Findings**[17]

	Cycle	Walk
Currently use this mode for leisure and recreation.	48%	85%
Currently use this mode for transportation.	24%	58%
Would like to use this mode more frequently.	66%	80%
Would cycle to work if there "were a dedicated bike lane which would take me to my workplace in less than 30 minutes at a comfortable pace."	70%	
Support for additional government spending on bicycling facilities.	82%	

Appropriate facilities and roadway improvements for walking and cycling (sidewalks, crosswalks, multi-use paths, bike lanes, traffic calming) can increase nonmotorized travel. One study found that each mile of bikeway per 100,000 residents increases bicycle commuting 0.075 percent, all else being equal.[18]

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15 Charles Komanoff and Cora Roelofs, *The Environmental Benefits of Bicycling and Walking*, National Bicycling and Walking Study Case Study No. 15, USDOT, January 1993, FHWA-PD-93-015.

16 "A Trend On the Move: Commuting by Bicycle." *Bicycling Magazine*, Rodale Press, April 1991.

17 Environics, *National Survey on Active Transportation*, Go for Green, (www.goforgreen.ca), 1998.

18 Arthur Nelson and David Allen, "If You Build Them, Commuters Will Use Them; Cross-Sectional Analysis of Commuters and Bicycle Facilities," *Transportation Research Record 1578*, 1997, pp. 79-83.

4. Evaluating Existing Conditions and Facilities[19]

Some transportation agencies use volunteers or hired college students to perform field surveys of pedestrian and cycling conditions. If possible, surveys should include special user groups, such as people in wheelchairs and elderly pedestrians, particularly in areas they frequent.

When evaluating facilities it is important to clearly maintain the distinction between *nominal* ("in name") and *functional* ("working condition") dimensions. For example, many sidewalks and paths are nominally 1.8 to 2 metres wide, but functionally they may be much narrower, due to objects such as telephone poles and signposts located in their right of way, and due to surface failures, such as cracks and potholes. As a result, a walkway that meets technical specifications may be inadequate for some potential users. Similarly, a bike lane may be useless if it has poor surface conditions or is frequently used for vehicle parking.

Example

Field Survey Data to Collect

- Vehicle traffic volumes and speeds.
- Nonmotorized traffic volumes and speeds.
- Special hazards to walking and cycling.
- Sidewalk, path, and trail conditions (effective width, surface condition, sight distances, etc.).
- Curb cuts, ramps and other universal access facilities.
- Pedestrian road crossing facilities.
- Lighting along streets and paths.
- Roadway and road shoulder widths and pavement conditions.
- Presence of parked cars adjacent to the traffic lane.
- Presence of potholes and dangerous drain grates.
- Bicycle parking facilities.
- Security, cleanliness, vandalism, litter, and aesthetic conditions.
- Public washrooms and other services along trails and bike routes.

It may be difficult to obtain consistent evaluations of roadway conditions by different surveyors. Some cyclists are comfortable riding on roads with heavy, high-speed traffic, and are critical of paths that restrict cycling riding speed due to design limitations. Other cyclists have the opposite preferences. This problem can be minimized by establishing clear evaluation criteria. For example, rather than simply rating a highway condition as "good" or "bad" for cycling it may be better to record traffic volumes, shoulder width, shoulder condition, and "special problems for cyclists." Training and supervision can help guarantee consistency between survey teams.

[19] See Appendix 3 for more information on evaluation techniques.

5. Identify and Evaluate Constraints and Opportunities[20]

Common constraints to nonmotorized travel include:

- Non-existent, incomplete, and poor quality sidewalks and crosswalks.
- Roads and bridges with heavy vehicle traffic and inadequate lane space for cyclists.
- Highways and other roadways with rough pavement, potholes, drain grates, or other surface irregularities along the right lane and shoulder.
- Wide roads and intersections that are difficult for pedestrians to cross.
- Rough railroad tracks crossing a roadway (particularly if at an angle).
- Inadequate lane space for bicycles.
- A lack of bicycle and pedestrian connections where it would be suitable, such as between a residential area and a school or shopping mall.
- Street environments that are perceived as unsafe to pedestrians, either due to crash risk or crime.
- Signal lights that are not activated by bicycles.

When evaluating constraints and potential improvements, consult current users (to identify the problems they encounter), potential users (to identify the problems they perceive), and experts (who may be able to provide technical information and suggestions).

It is important to differentiate between *nominal* (in name) and *functional* (working condition) when evaluating facilities. For example, typical sidewalks and paths are nominally 1.8 to 2 metres wide, which is sufficient for light- and medium volume pedestrian traffic, but functionally they may be much narrower due to objects such as telephone poles and signposts located in their right of way, and surface failures, such as cracks and potholes. As a result, a walkway that meets technical specifications may be inadequate for some potential users. Similarly, a bike lane may be useless if it has poor surface conditions or is frequently used for vehicle parking.

Design Concept

"Shy Distance"

Although a typical pedestrian or cyclist is only about 0.5 metres (1.5 feet) wide, when moving they need a buffer between themselves and other objects. Traffic engineers call this "shy distance." As traffic speeds increase, so do shy distance requirements. This should be taken into account when evaluating the adequacy of sidewalks and paths for the volumes and mixes of users. It means, for example, that two people walking quickly side-by-side typically require about 2 metres of total width (0.5 metres of body width each, plus 0.5 metres of shy distance on each side, and that a 3 metre sidewalk or path is just sufficient to comfortably accommodate a couple of pedestrians heading in one direction passing another pedestrian. Wider paths are needed to accommodate moderate speed skaters and cyclists.

[20] John Williams, Bruce Burgess, Peter Moe and Bill Wilkinson, *Implementing Bicycle Improvements at the Local Level*, FHWA, Report FHWA-RD-98-105, 1998.

Not all pedestrian and cycling improvements require a specific project or funding. Many improvements can be implemented by incorporating appropriate policies and standards into other projects. Implementation tasks may include:

- Adopting appropriate road, path and sidewalk design and maintenance standards.
- Changing development and zoning codes to require pedestrian and bicycle facilities in new developments and when old ones are reconstructed.
- Establishing nonmotorized transportation safety, law enforcement, and promotion programs.
- Establishing a pedestrian and bicycle coordinator position within a planning agency.
- Establishing nonmotorized transportation evaluation programs, including data gathering and ongoing public surveys, and consultation.

6. Prioritize Improvements[21]

Prioritization means identifying potential projects and ranking them from most to least desirable. There are four factors to consider when prioritizing improvements:

- *Level of demand.* How many people would use a facility if it were improved. In general, this increases around higher density areas, such as business districts and higher-density residential areas, and around attractions, such as schools and parks.
- *Degree of barrier.* This can range from minor (pedestrians must take a less direct route than desirable) to a total barrier ("you can't get there from here by walking or bicycling"). This is sometimes measured using Level-of-Service ratings of walking and cycling conditions.[22]
- *Potential benefits.* This refers to the benefits that could result from increased walking and cycling on that corridor. For example, improvements that encourage more nonmotorized commuting may be considered to have more value to a community than improvements that are used primarily for recreational cycling and walking.
- *Cost and ease of improvement.* This includes the incremental financial costs of the project, and any increase in future maintenance costs.

This information can be presented in an evaluation matrix, such as the one below. Note that "cost" is inverted into "affordability" so all criteria can be ranked from high (best) to low.

Table 4 **Project Evaluation Matrix Example**

	Demand	**Barrier Reduction**	**Benefit**	**Affordability (low cost)**
Proposal 1	High	High	Medium	High
Proposal 2	Medium	Low	High	Medium
Proposal 3	High	Medium	High	Low
Proposal 4	Low	High	Medium	Low

[21] See Appendix 3 for more information on evaluation techniques.

[22] Linda Dixon, "Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems," *Transportation Research Record 1538*, 1996, pp. 1-9.

It may be desirable to develop a more quantitative evaluation process. Each criterion can be assigned points from zero (worst) to 5 (best). These are then added to create total points for each project. More sophisticated strategies for prioritizing pedestrian and bicycling improvements are described in Appendix 3. Rankings can be done by a small group of technical experts, a technical/public committee, or through a public survey. This exercise should result in a list of projects ranked from highest to lowest priority.

Table 5 **Project Evaluation Matrix Example**

	Demand	**Barrier Reduction**	**Social Benefit**	**Affordability (low cost)**	***Total Points***
Proposal 1	4	4	3	4	*16*
Proposal 2	3	3	5	3	*15*
Proposal 3	5	3	4	1	*13*
Proposal 4	2	4	3	1	*10*

7. Budgeting and Evaluation[23]

Once projects are prioritized, the next step is to develop an implementation plan and budget proposal. The implementation plan should identify the order of tasks needed to implement each project, and who is responsible for that task. It should identify projects that are contingent on other activities, such as a path that would be built as part of a larger development, or a sidewalk that would be added when a particular road improvement project is implemented. The proposed budget can be based on an annual estimated expenditure, such as $100,000, or 5% of the transportation budget, or it can be based on a goal to implement all priority projects within a certain time frame, such as 10 years.

Some project may require special grants. Local jurisdictions can often apply for regional, state, provincial, or federal funds to implement pedestrian and bicycle projects. It is important to become familiar with appropriate grant programs, and maintain project proposals that are ready for submission. Contact your Metropolitan Planning Organization (MPO, for information visit www.ampo.org) or state/provincial transportation agency for more information.

Don't forget to budget for maintenance. Preventive maintenance reduces hazards and future repair costs. Use life cycle cost analysis to evaluate expenditures, such as the net value of using a higher quality, longer-lasting material. A good rule of thumb is that 5% of infrastructure replacement costs should be spent on annual maintenance. For example, if a bridge costs $100,000 to construct, $5,000 should be budgeted for its maintenance each year.

[23] See Appendix 3 for more information on evaluation techniques.

Planning Tip

How much funding should be devoted to walking and bicycling facilities[24]
Many people assume that motorist pay for roads through fuel taxes so it is unfair to devote road resources to bicycle and pedestrian facilities. It is sometimes suggested that cyclists should be charged a special license fee to fund their facilities. However, the local roads that are used most by pedestrians and cyclists are actually funded by local taxes that everybody pays regardless of how they travel. Since nonmotorized travel costs less to accommodate and motorists tend to travel far more kilometres per year than non-motorists, households that drive less than average tend to pay more taxes than the roadway costs they impose, while those that drive more than average tend to underpay their roadway costs.

It could be argued that, at a minimum, pedestrian and cycling programs should receive funding comparable to their portion of travel. For example, if 5% of trips on local streets are made by pedestrians and another 5% are made by bicycle, it would be fair to devote at least 10% of local transportation expenditures to nonmotorized transport. (As discussed later, most transportation surveys underestimate nonmotorized travel by ignoring or undercounting short tips, non-work trips, travel by children, and access links to motor vehicles.) However, there are reasons that communities may justify devoting even more resources to nonmotorized transportation:

- Nonmotorized transport programs have historically been underfunded so there are unmet needs.
- Nonmotorized transport help meets community livability, equity, and Transportation Demand Management (TDM) objectives.
- Nonmotorized transport serves both transportation and recreation purposes, so it deserves funding from two municipal budget categories: transport budgets for transportation-oriented facilities such as sidewalks, wider curb lanes and bike lanes, and recreation budgets for recreation-oriented facilities such as trails.

If possible, a minimum annual municipal budget allocation should be established. Additional funding may also be available from other sources, such as regional transportation budgets, the provincial Cycling Network Plan, and federal environmental or infrastructure funds.

Budgets and implementation programs should be flexible to allow for changing needs and opportunities. For example, scheduled maintenance or repairs on a particular roadway could allow pedestrian and cycling improvements to be included at minimal extra cost. In such a situation it may be sensible to change the plan's priorities to take advantage of such an opportunity.

It is important to consider early in the planning process how projects will be evaluated. This determines what data that should be collected before changes are implemented to allow before-and-after analysis. Project evaluation can help to assess whether program goals and objectives are appropriate, whether they are being met, whether a project is cost effective, and whether priorities, criteria and design factors should be changed.

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[24] Todd Litman, *Whose Roads? Defining Bicyclists' and Pedestrians' Right to Use Public Roadways*, VTPI (www.vtpi.org), 1998.

World Health Organization Charter on Transport, Environment and Health
www.who.dk/London99/transport02e.htm

Physical Activity
Lack of physical activity is one of the major risk factors for coronary heart disease, which is the leading cause of mortality in Europe. On the other hand, walking and cycling as daily activities can promote health by providing physical activity, decreasing noise, and air pollution.

The health benefits of regular physical activity can be summarized as:

- 50% reduction in the risk of developing coronary heart diseases (i.e. a similar effect to not smoking).
- 50% reduction in the risk of developing adult diabetes.
- 50% reduction in the risk of becoming obese.
- 30% reduction in the risk of developing hypertension. 10/8 mm Hg decline in blood pressure in hypertensive subjects (i.e. a similar effect to that obtained from antihypertensive drugs).
- Other effects include reduced osteoporosis, relief of symptoms of depression and anxiety, and the prevention of falls in the elderly.

A total of 30 minutes' brisk walking or cycling on most days of the week, even if carried out in 10–15 minute episodes, is effective in providing these health benefits.

The average trip by walking in Europe is about 1.5 km and the average cycling trip is about 3.5 km, each taking about 15 minutes to make: two such trips each day would be enough to provide the recommended "daily dose" of physical activity.

Psychosocial effects
Certain patterns of transport have a broad range of effects on mental health, including risk-taking and aggressive behaviors, depression, and post-traumatic psychological effects of crashes.

High levels of traffic can cause social isolation and limit interpersonal networks of support, factors which have been found to be associated with higher mortality and morbidity in the elderly.

Children who have the opportunity of playing unhindered by street traffic and without the presence of adults have been found to have twice as many social contacts with playmates in the immediate neighbourhood as those who could not leave their residence unaccompanied by adults due to heavy traffic.

The fear of collisions is reported by parents as being the main reason for taking children to school by car. This hinders the development of children's independence and reduces their opportunities for social contact. It also has an influence on children's attitudes towards car use and personal mobility in adulthood.

The lack of physical activity, including walking and cycling, is associated with mental ill health, including depression.

8. Economic Development Impacts of Nonmotorized Transport

Nonmotorized transport can support economic development in several ways described below.[25]

Regional Economic Productivity and Development
Excessive automobile dependency imposes significant economic costs that can reduce economic productivity and development. These include increased vehicle and facility costs, congestion, less efficient land use, and economic costs from collisions and pollution.[26] Expenditures on automobiles and fuel provide little regional economic activity because they are capital intensive and mostly imported from other regions. A recent study indicates that automobile expenditures provide far less regional economic activity and employment than most other consumer expenditures, indicating that reducing automobile dependency tends to increase economic development.

Table 6 **Regional Economic Impacts of $1 Million Expenditure**[27]

Expenditure Category	Regional Income	Regional Jobs
Automobile Expenditures	$307,000	8.4
Non-automotive Consumer Expenditures	$526,000	17.0
Transit Expenditures	$1,200,000	62.2

This table shows economic impacts of consumer expenditures in Texas.

Community Amenities
Nonmotorized facilities such as public trails can stimulate tourist activity, increase property values, and help attract certain types of industries, particularly knowledge-based businesses with employees who place a high value on amenities such as environmental quality, access to greenspace, and outdoor recreation.[28]

Local Business Activity
Some commercial districts find that nonmotorized transport increases business activity. Nonmotorized transport land requirements for roads and parking, and commercial destinations can be located in closer proximity to one another. This allows for both greater site flexibility and efficiency, and generates financial savings from reduced parking requirements. A study in Bern, Switzerland found that cyclists spend far more money per area of commercial parking than motorists. Only 25% of motorists buy more than 2 bags of shopping - a quantity easily shipped by bike or on foot, while 17% of cyclists also buy 'car sized' loads and take it home.[29]

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[25] Jeroen Buis, *The Economic Significance of Cycling; A Study to Illustrate the Costs and Benefits of Cycling Policy*, VNG uitgeverij (The Haag; www.vnguitgeverij.nl) and I-ce (www.cycling.nl), 2000.

[26] Peter Newman and Jeff Kenworthy, *Sustainability and Cities; Overcoming Automobile Dependency*, Island Press (Covelo; www.islandpress.org), 1998; Todd Litman and Felix Laube, *Automobile Dependency and Economic Development*, VTPI, (www.vtpi.org), 1998.

[27] Jon Miller, Henry Robison & Michael Lahr, *Estimating Important Transportation-Related Regional Economic Relationships in Bexar County, Texas*, VIA Transit (San Antonio; www.viainfo.net), 1999.

[28] *Economic Impacts of Protecting Rivers, Trails and Greenway Corridors*, U.S. National Park Service (www.nps.gov/pwro/rtca/econ_index.htm), 1995; *Economic and Social Benefits of Off-Road Bicycle and Pedestrian Facilities*, Technical Brief, Nat. Bicycle & Pedestrian Clearinghouse, (www.bikefed.org), 1995; "Evaluation of the Burke-Gilman Trail's Effect on Property Values and Crime," *Transportation Research Record 1168*, 1988, pp. 57-59.

[29] *Cycling The Way Ahead For Towns And Cities*, European Community, 1999, ISBN 92-828-5724-7 EC

Cost Effective mobility
The majority of packages delivered weigh less than 30Kkg, loads easily transported on foot or by bicycle. Nonmotorized deliveries are often faster than by automobile, and are far cheaper in terms of operating, facility (roads and parking) and congestion costs. Surveys indicate that only about 25% of shoppers actually carry away a load that would be difficult to manage on foot or bike.

Police and some emergency response personnel find that they can perform more effectively by bicycle rather than car. They are swift, quiet and approachable, and can reach more destinations that motor vehicles.

Bicycle parking is far cheaper than automobile parking, and can often be incorporated into currently unused spaces. Employees who bicycle to work reduce parking costs and leave more parking available for customers.

Resources

Economic Development Impacts of Nonmotorized Transport

Cycling The Way Ahead For Towns And Cities, DG XI - Environment, Nuclear Safety and Civil Protection, European Community, 1999, ISBN 92-828-5724-7 EC no CR-17-98-693-EN-C, Free from DG XI Fax: +32 2 299 0307.

Todd Litman and Felix Laube, *Automobile Dependency and Economic Development*, VTPI (www.vtpi.org), 1999.

Todd Litman, *First Resort; Resort Community TDM*, VTPI (www.vtpi.org), 1999.

no CR-17-98-693-EN-C, Free from DG XI Fax: +32 2 299 0307.

III. Nonmotorized Transportation Planning

Pedestrians and cyclists have both similarities and differences that must be considered in planning, as illustrated below. This section of the guide examines combined planning issues, particularly the development of multi-use trails. Later there are separate sections on pedestrian planning and bicycling planning which address their unique features.

Comparing Pedestrians and Bicyclists

Similarities

- Tend to be slower than motor vehicle traffic.
- Vulnerable to weather, traffic volumes and speeds, pollution.
- Are unlicensed.
- Include wide range of ages and abilities (may include people with special needs).

Differences

- Bicyclists can travel much faster and farther than pedestrians.
- Pedestrians are the slowest mode, can change directions quickly, and frequently stop.
- Bicyclists can ride on roadway and follow vehicle traffic rules.
- Pedestrians require separated facilities.

1. Integrating With State or Provincial Planning

Your local plan should integrate with planning by other agencies including departments of transportation, transit, and ferry companies.

2. Planning Multi-Use Trails

Multi-use trails (trails that accommodate a variety of uses, including walking, bicycling, skating, skiing, and sometimes horses) are popular and an important part of many community's nonmotorized transportation system. It is likely that your planning process will identify many potential multi-use paths and trails.

Multi-use trails must be adequately designed, built, and maintained if they are to make a useful contribution to nonmotorized transport. Trails must be more than just an extra wide sidewalk; they should make connections and go where roads do not, and provide an extra safe and pleasant environment. Designs should meet standards established by professional organizations, such as AASHTO and the Canadian Institute of Planners.

A trail system should be integrated with other pedestrian and bicycle facilities, and connected to popular destinations, including parks, schools, colleges, employment centers and commercial centers. Connections with the street system should be carefully designed, and signed to indicate street name and path destination. A high-quality multi-use trail, such as a converted railroad right-of-way, can become the core of a regional trail system that will expand in the future.

A multi-use path is not a substitute for adequate on-street facilities. All roadways should be safe for cycling to accommodate cyclists who ride too fast for trails or have destinations not served by the path. Similarly, sidewalks may be needed along roadways for pedestrian access to certain destinations, even if a path is nearby.

Resources

Planning Trails and Other Nonmotorized Facilities

Alta, *Best Practices Analysis in Rails-With-Trails*, Alta Transport Consulting (www.altaplanning.com), 2001.

American Trails (www.outdoorlink.com/amtrails) fosters communication among trail users.

AASHTO, *Guide for the Development of Bicycle Facilities, 3rd Edition*, American Association of State Highway and Transportation Officials (Washington DC; 888-227-4860; www.aashto.org), 1999; available online at www.bikefed.org.

David Engwicht, *Street Reclaiming; Creating Livable Streets and Vibrant Communities*, New Society Publishers (www.newsociety.com), 1999.

Greenways: A Guide to Planning, Design, and Development, 1993. The Conservation Fund. Island Press, 1718 Connecticut Ave. NW, Suite 300; Washington, DC 20009.

Manual on Uniform Traffic Control Devices (MUTCD), FHWA (http://mutcd.fhwa.dot.gov) "Part IX: Traffic Controls for Bicycle Facilities" provides facility sign and marking standards.

BTS, *Bicycle and Pedestrian Data: Sources, Needs & Gaps*, USDOT (www.bts.gov/programs/transtu/bikeped/report.pdf), 2000.

National Bicycle and Walking Study (24 volumes), FHWA, (www.bikefed.org), 1991-95.

NHI, *Pedestrian and Bicyclist Safety and Accommodation; Participant Workbook*, National Highway Institute Course #38061, FHWA, 1996, information at www.ota.fhwa.dot.gov/walk.

Northwestern University Traffic Institute (Evanston, Illinois; 800-323-4011; www.nwu.edu/traffic) offers professional bicycle planning and facility design workshops.

Oregon Bicycle and Pedestrian Planning (www.odot.state.or.us/techserv/bikewalk) is an example of nonmotorized planning at its best.

The **Pedestrian and Bicycle Information Center** (1-877-WALKBIKE; www.bicyclinginfo.org) provides a variety of technical information on nonmotorized transport planning and programs.

Suzan Anderson Pinsof and Terri Musser, *Bicycle Facility Planning*, Planners Advisory Service, American Planning Association (Chicago; 312-786-6344), 1995.

Rails-to-Trails Conservancy, (202-331-9696; www.railtrails.org) provides many resources, including *Improving Conditions for Bicycling and Walking; A Best Practices Report*.

TAC, *Bikeway Traffic Control Guidelines*, Transportation Association of Canada (Ottawa; 613-736-1350; www.tac-atc.ca), 1999.

Turner-Fairbank Highway Research Center (www.tfhrc.gov), Pedestrian and Bicycle Planning.

Rails-To-Trails Conservancy (www.railtrails.org) is an organization dedicated to helping communities develop public trails. It provides a variety of information and resources.

SWOV, *Best Practice to Promote Cycling and Walking*, Denmark Ministry of Transport (vd@vd.dk), European Commission Directorate General of Transport, 1998.

University of North Carolina Highway Safety Research Center (www.hsrc.unc.edu).

The WSDOT Pedestrian website (www.wsdot.wa.gov) provides information about Washington State's outstanding pedestrian and bicycle planning programs.

3. Dealing With Trail Conflicts

Many public trails are quite popular, particularly during peak periods. Trail planning should include strategies to minimize conflicts between users. The following are principles for minimizing trail conflicts:[30]

1. Recognize that trail conflicts may exist.
2. Provide adequate trail opportunities.
3. Minimize the number of contacts between users in problem areas.
4. Involve users as early as possible in planning trails.
5. Understand user needs.
6. Identify the actual sources of conflict.
7. Work with affected users.
8. Promote trail etiquette.
9. Encourage positive interactions among different users.
10. Favor "light-handed management."
11. Plan and act locally.
12. Monitor progress.

Tip

Trail Etiquette[31]
The key word is multi-use. Share the trail. Keep right except to pass. Motorized vehicles are prohibited (except for motorized wheelchairs). Respect private property adjacent to the trail.

- If you're on foot or on wheels, pass horseback riders with caution – horses can spook at startling noises or motions.
- If you're on horseback, let other trail user know when your horse is safe to pass.
- If you're cycling, yield to pedestrians, control your speed, and warn – call out or use a bell – other trail users before passing.
- If you're walking your dog, keep it under control or on a leash, please pick up its droppings.

4. Facility Maintenance

It is not enough to simply build new facilities. A nonmotorized facility plan should include maintenance policies. It should identify the agencies responsible for maintaining facilities, the maintenance standards that are to be applied, how users should report maintenance needs, and special activities such as snow clearing and litter cleanup. Maintenance inspections should be performed routinely in conjunction with a Spot Improvement Program (discussed in more detail in the next section).

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[30] Roger L. Moore, *Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice*, Federal Highway Administration, FHWA-PD-94-031 (www.bikefed.org), 1994.

[31] Jim Mulchinoch, *The Official Guide: The Galloping Goose Regional Trail*, Capital District Regional Parks (Victoria; www.crd.bc.ca/parks/pdf/galgoos2.pdf), 1996.

Trail and Path Maintenance Recommendations[32]

- *Establish a maintenance policy and plan* – Establish written procedures that specify maintenance standards, schedule, quality control, and follow-up that will be used for pedestrian facilities, based on "current best practices."
- *Repairs* – Inspect trails and paths regularly for surface irregularities, such as potholes and cracks, and damage to signage and lighting. Repair potentially hazardous conditions quickly.
- *Establish a citizen reporting system* – Encourage citizens to report pedestrian and bicycle facility maintenance needs or other problems. Publicize a particular telephone number and email address for submitting information.
- *Sweeping* - Establish a seasonal sweeping schedule. In curbed areas sweepings should be picked up, on open shoulders, debris can be swept onto gravel shoulders. In the fall, provide extra sweepings to pick up fallen leaves.
- *Vegetation* – Vegetation may impede sight lines, or roots may break up the travel surface. Vegetation should be cut back to ensure adequate sight lines, and intrusive tree roots may be cut back to keep the walkway surface smooth and level.
- *Drainage* – Malfunctioning drainage systems may cause accumulations of water at pedestrian crossings.
- *Snow Removal* – Snow and ice can make pedestrian travel slow and hazardous. Snow should be removed from sidewalks to ensure safe passage of pedestrian facilities.
- *Street Markings* – bike lane and crosswalk markings may become difficult to see over time. These should be inspected regularly and retraced when necessary.
- *Utility Cuts* – Poorly performed sidewalk cuts for utilities may leave an interrupted surface for pedestrians. Cuts in sidewalk should be back filled with concrete to the sidewalk grade – so the result is as smooth as a new sidewalk.

Roadway Maintenance Requirements
What may be an adequate pavement surface for automobiles (with four wide, low-pressure tires) can be hazardous for cyclists (two, high-pressure tires). Small rocks, branches, and other debris can deflect a wheel, minor ridges in the pavement can cause spills, and potholes can cause wheel rims to bend. Wet leaves are slippery and cause cyclists to fall. Gravel blown off the travel land by traffic accumulates in the area where bicyclists ride. Broken glass can easily puncture tires.

5. Spot Improvement Programs

Some communities have "spot improvement programs," which provide an ongoing process to identify and implement small projects that improve walking and cycling conditions, such as repairing potholes and rough road shoulders, installing curbcuts, and making signal loops sensitive to bicycles. Users are encouraged to help identify needed improvements through a telephone hotline or request form distributed through bicycle shops and organizations.

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[32] *Maintenance of Bicycle and Pedestrian Facilities*, NBPC Technical Assistance #6 (wsdot.wa.gov/hlrd/PDF/MaintBicPedArticle.pdf), 1995; E. Gallagher and V. Scott, *Taking Steps; Modifying Pedestrian Environments to Reduce the Risk of Missteps and Falls*, STEPS Project, School of Nursing, University of Victoria (Victoria), 1996.

6. Pedestrian and Bicycle Needs At Construction Projects

Roadway and sidewalk construction projects can disrupt mobility and create special hazards for pedestrians and cyclists.[33] The following recommendations should be incorporated into project plans to minimize these problems.

- On highways, enough space should be left at the edge of the construction site to allow a vehicle to pass a cyclist.
- Barricades and pylons can be used to create a temporary passageway for pedestrians. This is particularly important in urban areas. Sidewalk closures should be avoided or minimized as much as possible. Passageway should be wide enough to accommodate a wheel chair, and should have ramps where there are height changes.
- In urban areas, bicyclists may share the lane with lower speed traffic, or a temporary bike lane may be installed. Avoid routing bicycles onto sidewalks or onto unpaved shoulders.
- Construction signs should not obstruct bicycle and pedestrian paths. Where this is unavoidable, do not block more than half the path or sidewalk.
- Bus stops must remain accessible to pedestrians. Where necessary, bus stops may be relocated provided clear and noticeable signs are provided.
- Additional lighting may be required at night to identify hazards.

7. Pedestrian and Bicycle Coordinators

The responsibility for nonmotorized transport planning should be clearly established within an agency to help maintain continuity through the process and develop necessary contacts and expertise. This is especially important because nonmotorized transportation planning crosses traditional institutional categories (involving planning, engineering, safety education, recreation, and marketing). Typical pedestrian/bicycle coordinator responsibilities include:

- Work with other departments and agencies to co-ordinate bicycle and pedestrian programs, plans, and policies in the region.
- Coordinate educational opportunities for designers, traffic technicians, and police in dealing with the needs and concerns of pedestrians and cyclists.
- Review standards, plans, and development proposals to determine whether they meet the needs of pedestrians and cyclists.
- Review designs for municipal roads and highways to ensure appropriate consideration for cyclists and pedestrians, and that facilities meet national design standards.
- Work with local advocacy and safety groups to help support nonmotorized promotion and safety efforts.
- Maintain a database of cycling and pedestrian traffic volumes, complaints, and collisions to identify locations needing improvements.

[33] Gerald Donaldson, "Work Zone Pedestrian Safety," in *Design and Safety of Pedestrian Facilities: A Recommended Practice of the Institute of Transportation Engineers*, ITE (www.ite.org), 1998.

8. Crime Prevention Through Environmental Design (CPTED)

Crime Prevention Through Environmental Design (CPTED) is concerned with designing the local environment to minimize opportunities for crime. Local police may be trained to perform "safety audits" to identify design strategies to increase personal safety. Paths intended for day and evening use are more secure if located near residences, which provide passive surveillance. Lighting should be adequate to remove very dark areas at night, and vegetation should be managed to ensure good sight lines, minimal places to hide, and ensure paths are visible to surrounding areas.[34] The placement of bicycle parking facilities should also be well considered to reduce the likelihood of bicycle theft.

The following guidelines, adapted from *Safe Cities: Guidelines for Planning, Design and Management*, can be used to make cycling facilities and routes safer so that people will not be afraid to use them.

- Is there adequate visibility of parked bicycles, and for people in the process of locking and unlocking their bicycles from people passing by, in adjacent buildings, or from station attendants?
- Are there entrapment spots? Are there dark isolated spaces near the bicycles?
- Is there a clear system of through routes on city streets, preferably not separated by visual barriers?
- Are the routes clearly sign-posted, not only on the route but along major roads feeding into the route?
- Are commuting routes chosen not only for convenience and lack of detours, but also for security? This means locating bicycle routes adjacent to areas of high pedestrian and car traffic during the day and evening, with as much continuous building, as few "empty spaces" and as few underground crossings as possible. Separating bicycle paths from both pedestrian and automobile traffic makes them more vulnerable.
- Are the routes well lit?
- Do they avoid underground crossings?
- Are there bushes and dense clusters of trees avoided immediately adjacent to the route?

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[34] Tom McKay, "The Right Design for Reducing Crime; Crime Prevention Through Environmental Design," *Security Management Magazine* (www.peelpolice.on.ca/cpbook.html), March 1996.

Resources

Crime Prevention Through Environmental Design

Canadian National Crime Prevention Centre (www.crime-prevention.org)

Crime Prevention From the Ground Up, National Council for the Prevention of Crime (www.ncpc.org/2add4dc.htm).

Design and Crime Program, Nottingham Trent University (www.ntu.ac.uk/soc/psych/miller/crime.htm).

Social Research Associates, *Personal Security Issues in Pedestrian Journeys*, UK Department of the Environment, Transport and the Regions (London; www.mobility-unit.detr.gov.uk/psi), 1999.

Tom McKay, "The Right Design for Reducing Crime; Crime Prevention Through Environmental Design," *Security Management Magazine* (www.peelpolice.on.ca/cpbook.html), March 1996.

Wekerle and Whitzman, *Safe Cities: Guidelines for Planning, Design and Management*, Van Nostrand Reinhold, 1995.

WAC, *Safety Audit Guide*, Women's Action Centre Against Violence (Ottawa, 613-241-5414; wacav@istar.ca; http://geocities.com/herzing3), 1996. $25 Canadian.

What is Crime Prevention Through Environmental Design? Alberta Community Crime Prevention Association, University of Alberta (www.ualberta.ca/ACCPA/cpted.htm).

IV. Planning for Pedestrians

Accommodating pedestrians is critical for a quality community. Walking is the most basic form of transportation, and pedestrian conditions affect public transit use, since transit riders usually walk for mobility at their destinations. The pedestrian environment provides public space where people can meet and interact. Creating an attractive and safe pedestrian environment is a critical part of developing more livable communities.

Principles for Pedestrian Design[35]

1. The pedestrian environment should be safe.
Sidewalks, pathways, and crossings should be designed and built to be free of hazards and to minimize conflicts with external factors such as noise, vehicular traffic, and protruding architectural elements.

2. The pedestrian network should be accessible to all
Sidewalks, pathways and, crosswalks should ensure the mobility of all users by accommodating the needs of people regardless of age or ability.

3. The pedestrian network should connect to places people want to go.
The pedestrian network should provide continuous direct routes and convenient connections between destinations, including homes, schools, shopping areas, public services, recreational opportunities, and transit.

4. The pedestrian environment should be easy to use.
Sidewalks, pathways, and crossings should be designed so people can easily find a direct route to a destination and delays are minimized.

5. The pedestrian environment should provide good places.
Good design should enhance the look and feel of the pedestrian environment. The pedestrian environment includes open spaces such as plazas, courtyards, and squares, as well as the building facades that give shape to the space of the street. Amenities such as street furniture, banners, art, plantings, and special paving, along with historical elements and cultural references, should promote a sense of place.

6. The pedestrian environment should be used for many things.
The pedestrian environment should be a place where public activities are encouraged. Commercial activities such as dining, vending, and advertising may be permitted when they do not interfere with safety and accessibility.

7. The pedestrian environment should be economical.
Pedestrian improvements should be designed to achieve the maximum benefit for their cost, including initial cost and maintenance cost as well as reduced reliance on more expensive modes of transportation. Where possible, improvements in the right-of-way should stimulate, reinforce, and connect with adjacent private improvements.

35 *Pedestrian Master Plan*, Pedestrian Transportation Program, City of Portland (503-823-7004; pedprogram@syseng.ci.portland.or.us), 1998.

1. Types of Pedestrians

Pedestrians have special characteristics that must be considered in planning. They are highly diverse, including joggers, healthy adults in a hurry, groups enjoying a leisurely stroll, people carrying packages, people stopped to tie a shoe or enjoy a view, parents with children, people with pets on a leash, the elderly, and people using mobility aids. Pedestrian traffic averages about 4 feet per second (4.5 kilometers per hour), with a range of 2.5 to 8.0 feet per second (2.8 to 9.0 kilometers per hour), or even more.[36]

Facilities should be designed to meet the needs of all users. Pedestrian space requirements range from less than 1 square metre to several square metres for people with a cart, a pet on a leash, or a group. Steps, steep inclines, and surface irregularities can present significant obstacles to children, seniors, people with disabilities, and people using strollers or handtrucks. The lack of a sidewalk or ramp may mean little to an able-bodied person, who can sidestep the inconvenience, but some pedestrians may need to use an alternative route just to descend a curb.

Pedestrians generally travel more slowly than any other mode. They may be difficult for drivers to see and are vulnerable to injury if hit by a vehicle, particularly when traffic speeds are moderate or high. Pedestrians are particularly sensitive to traffic congestion, detours, roadway conditions, street aesthetics, and perception of street crime.

[36] "Roadway Design Considerations," in *Design and Safety of Pedestrian Facilities: A Recommended Practice of the Institute of Transportation Engineers*, ITE (www.ite.org), 1998, p. 8.

2. Pedestrian Facilities and Planning

Pedestrian facilities include paths, sidewalks, crosswalks, walkways, stairs, ramps, and building entranceways. High quality pedestrian facilities should be incorporated in all urban developments. There are three general ways to implement pedestrian facilities:

- Require pedestrian facilities in new private construction. This can be done through design standards and zoning laws, and negotiated as part of project development approval.
- Incorporate pedestrian facilities in scheduled municipal projects, such as roadway construction and reconstruction.
- Projects funded by municipal governments, local improvement districts, or property owners.

Pedestrian planning involves more than just providing and maintaining sidewalks and paths. It also requires consideration of pedestrian needs in roadway design. The pedestrian environment can be enhanced with more human-scale streets with narrower roadway widths, lower traffic speeds, smaller corner radii, planter strips, crosswalks (particularly crosswalks with signals, curb bulges, textured surfaces, raised surfaces, and adequate lighting), street trees, and pedestrian amenities. Traffic calming strategies, described later in this report can also significantly improve the pedestrian environment.

Parking lots can be high-risk areas for pedestrians. Parking facility design guidelines are available that include strategies to reduce pedestrian risks.[37] For example, parking lots should have walkways to channel pedestrians safely across traffic lanes, and defines ways to improve pedestrian visibility and security.

The pedestrian environment can also be enhanced with land use policies that result in more mixed use development (so residences, employment centers and commercial businesses are within walking distance of each other), narrow road widths, a more connected street network (minimal dead-ends and cul de sacs), and more human-scale development. Resources for this type of community design are described later in this report in the Livable Communities section.

Planning Tip

Pedestrian Underpasses
The following guidelines are recommended for pedestrian underpasses:

(1) Always provide a clear view from one end of the underpass to the other, and if at all possible avoid any curvature, either horizontal or vertical.

(2) Make the motor vehicles climb a few degrees on the overpass so that pedestrians and cyclists can pass underneath at grade. Downhill slopes into an underpass should be avoided to keep cyclists from attaining excessive speeds.

(3) Don't build stairs down to underpasses; they discriminate against the nonmotorized users and deter use of the system.

(4) Provide bright, attractive and secure lighting throughout the underpass at all times.

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[37] G.D. Hamilton Asso., *Safety Design Guidelines for Parking Facilities; A Recommended Practice*, Road Improvement Program, ICBC (Vancouver; www.icbc.com), 1998.

3. Pedestrian Standards and Improvements

The City of Portland's *Pedestrian Design Guide* is an excellent resource for pedestrian planning. It provides detailed, practical instructions for designing and implementing pedestrian facility improvements and policies that support pedestrian travel. Another excellent source is the *Pedestrian Facilities Guidebook* developed by the Washington State Department of Transportation. Pedestrian facility design guidelines are being developed by various professional organizations (AASHTO, ITE, TRB).

A pedestrian plan usually includes:

1. Design, construction and maintenance standards for sidewalks, crosswalks, paths, and sidewalk furniture.
2. Priorities for pedestrian improvements, including new sidewalks, crosswalks, paths, traffic calming, new mid-block short cuts, and new connections for dead-end streets.
3. Pedestrian improvement funding options.

Pedestrian Commercial Districts

Pedestrianized commercial districts ("Mainstreets") can be important for urban revitalization, although they must be carefully implemented to be effective. [38] They can help create a lively and friendly environment that attracts residents and visitors. Some are closed to motor vehicle traffic altogether, or during some time periods, such as evenings or weekends, while others use traffic calming design strategies to control traffic speeds and volumes.[39]

Business and residents should be involved in planning and managing pedestrian commercial streets. Often, a downtown business organization or Transportation Management Association will oversee streetscape development, as well as parking management and promotion activities.

Pedestrian Commercial Street Guidelines

- Pedestrian streets are only successful in areas that are attractive and lively. They require a critical mass of users. They should form a natural connection route for diverse attractions (tourist activities, shops, offices, etc.), and serve as both a destination and a thoroughfare.
- Develop a pleasant environment, with greenery, shade and rain covers. Use brick, block pavement or textured cement instead of asphalt, if possible. Street-level building features and street furniture should be pedestrian scale and attractive. Avoid blank walls on buildings.
- Develop a variety of pedestrian-oriented retail shops and services that attract a broad range of customers and clients. If possible there should also be offices and residential apartments, preferably located over shops.
- Allow motor vehicles as required for access, with appropriate restrictions based on need, time and vehicle type. This may include unrestricted motor vehicle traffic during morning hours, transit and HOV vehicles, pickup and drop-off for residents and hotels, service and emergency vehicles, or other categories deemed appropriate.
- Pedestrian streets should have good access to public transit and parking. They should be located in a pedestrian-friendly area. Mid-block walkways and buildings open to through public traffic should be developed and enhanced as much as possible.
- Security, cleanliness and physical maintenance standards must be high.
- Provide a range of artistic, cultural and recreational amenities (statues, fountains, playgrounds) and activities (concerts, fairs, markets). Highlight historical features.
- Pedestrian streets should generally be small and short, typically just a few blocks in length.
- Vehicle traffic on cross-streets should be slowed or restricted.

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[38] Amanda West, "Pedestrian Malls: How Successful Are They?" *Main Street News* (www.mainst.org/pedmallarticle.htm), Sept. 1990; Kent Robertson, "the Status of the Pedestrian Mall in American Downtowns," *Urban Affairs Quarterly*, Vol. 26, No. 2, Dec. 1990, pp. 250-273; Norm Tyler, *Downtown Pedestrian Malls*, (www.emich.edu/public/geo/557book/c120.auto.html).

[39] Ian Boyd, "Pedestrian-Oriented Environments," in *Design and Safety of Pedestrian Facilities: A Recommended Practice of the Institute of Transportation Engineers*, ITE (www.ite.org), 1998.

Planning Tip

Planning for Large Pedestrian Crowds
(Experience from the 2000 Olympics in Sydney, by Ian Napier, Secretary, Pedestrian Council of Australia)

Up to half a million pedestrians were moved in, out or through the Homebush Bay site on the busier days of competition and from my observation and others reports it worked very well. The lessons from it were:

- Avoid, where possible, two-way pedestrian routes. (The main flows were organised in huge one-way converging and diverging loops and where necessary temporary overpasses had been put in so that the conflicting flows could cross.)
- Keep people moving where possible. This of course has its limits. People will start to resent being moved just for the sake of it especially if they know the territory and are aware that they are being sent the long way round. Generally there is the reassurance however that one is making progress.
- Keep people informed at all times. The information is in a number of forms - the fixed signs using internationally recognisable symbols wherever possible, -large programmable message screens (more familiar as warning signs for roadworks on highways), - people with loud hailers on raised positions able to direct and inform the crowds, easily identified staff (in this case usually volunteers) able to monitor progress and answer questions at ground level. - fixed and clearly identified information booths.
- Keep people amused/entertained- here we were blessed with an army (not THE army, although they were in the background if needed) of goodnatured, tolerant, and often very amusing, volunteers who have been hailed as the secret of Sydney. Street performers and musicians were located at critical points where queues were anticipated. There were even stories of railway staff breaking into song and announcing trains in rhyming couplets.
- Provide escape routes and eddy spaces so that people don't feel trapped in crowds
- Provide shady and sheltered places that people can rest and relax between events.
- Provide diversions for children of all ages.
- Build in sufficient flexibility to cope with varying numbers and unexpected eventualities. For example, queuing races (barriers used to shape lines) can be short circuited when the crowds are smaller.
- Raising (or lowering as the case may be) expectations in order to modify behaviour. By the time the Olympics arrived no one in their right mind expected that they could drive all the way to events. They expected queues and long walks and in the end seemed to accept that with good humour.

4. Universal Design (Including Access for People with Disabilities)

It is important that public facilities be accessible to the greatest number of people including those with disabilities. This is called "universal design." A variety of universal design guides and standards are available.

Resources

Accessible Design

The **Access Board** (800-872-2253; www.access-board.gov) is a U.S. federal agency that develops policies and recommendations for accessible design. Publications include *Accessible Rights of Way: A Design Manual*, 1999; *ADA Accessibility Guidelines for Buildings and Facilities*, 1998; *Uniform Federal Accessibility Standards*; and *Designing Sidewalks and Trails for Access, Part One.*

American Council of the Blind (1155 15th Street NW, Suite 720, Washington, DC 20005; 202-467-5081; www.acb.org/pedestrian) supports programs to help people with visual impairments, including pedestrian improvements.

Beneficial Designs, Inc. et al., *Designing Sidewalks and Trails for Access; Review of Existing Guidelines and Practices*, USDOT, Publication No. FHWA-HEP-99-006, 1999.

Access Exchange International (San Francisco; globalride-sf@worldnet.att.net) is a non-profit organization that provides resources and coordination to develop cost-effective handicapped access in developing as well as developed countries.

Institute on Independent Living (www.independentliving.org) serves self-help organisations of disabled people. Full-text online library including access and transport issues.

Access Management Publications, U.S. National Transportation Library (www.bts.gov/ntl/subjects/access.html).

E. Gallagher and V. Scott, *Taking Steps; Modifying Pedestrian Environments to Reduce the Risk of Missteps and Falls*, School of Nursing, University of Victoria (www@aimnet.bc.ca), 1996.

Pedestrian Access Guidelines, City of North Vancouver, (www.cnv.org), 1998.

PLAE, Inc., *Universal Access to Outdoor Recreation: A Design Guide*, 1993, MIG Communications, 1802 Fifth Street, Berkeley, CA 94710. (510) 845-0953.

Recommended Street Design Guidelines for People Who Are Blind or Visually Impaired. American Council of the Blind (www.acb.org), (202) 467-5081.

US Federal Highway Administration Accessibility Website (www.dot.gov/accessibility).

U.S. Department of Justice ADA Homepage (www.usdoj.gov/crt/ada/adahom1.htm) provides information on implementing the Americans with Disabilities Act.

Resources

Pedestrian Planning

America WALKs (www.webwalking.com/amwalks) is a coalition of walking advocacy groups.

FHWA, *A Walkable Community; Your Town USA*, FHWA-SA-00-010, USDOT (http://safety.fhwa.dot.gov/programs/ped_bike.htm), 2000.

ITE, *Design and Safety of Pedestrian Facilities*, Institute of Transportation Engineers (Washington DC; www.ite.org), publication RP-026A, 1998, US$38.

National Transportation Week Pedestrian Website (www.ota.fhwa.dot.gov/ntw/bikeped.htm) provides information and links to pedestrian planning websites.

Pedestrian Planning Guidebook; Incorporating Pedestrians in Washington's Transportation System, Washington State DOT (www.wsdot.wa.gov/hlrd/PDF/PedFacGB.pdf)

Partnership for a Walkable America, (http://nsc.org/walk/wkabout.htm) promotes the benefits of walking and supports efforts to make communities more pedestrian friendly.

Pedestrian Crossing Control Manual, Transportation Asso. of Canada (www.tac-atc.ca), 1998.

Pednet's *International Pedestrian Lexicon* (glossary) (http://user.itl.net/~wordcraf/lexicon.html)

Rhys Roth, *Getting People Walking: Municipal Strategies to Increase Pedestrian Travel*, WSDOT (Olympia; www.wsdot.wa.gov/ta/t2/t2pubs.htm), 1994.

UK Department of the Environment, Transport and the Regions (www.roads.detr.gov.uk/roadsafety/rs/index.htm) publishes *Road Safety Education in Schools - Good Practice Guidelines* that describe how to create a safer pedestrian environment.

The U.S. Federal Highway Administration's pedestrian program (www.ota.fhwa.dot.gov/walk) provides pedestrian safety information and resources.

Portland Office of Transportation, *Portland Pedestrian Design Guide* and *Pedestrian Master Plan*, City of Portland (www.trans.ci.portland.or.us/Sidewalks_and_Pedestrians.html), 1998.

The **Pedestrian and Bicycle Information Center** (1-877-WALKBIKE; www.bicyclinginfo.org) provides a variety of technical information on nonmotorized transport planning and programs.

Walkable Communities, Inc. (www.walkable.org) works with communities to create more people-oriented environments.

Walkability Checklist, Partnership for a Walkable America (http://nsc.org/walk/wkabout.htm) is a survey that allows children and parents assess how "walkable" their neighborhood is.

Walking Steering Group, *Developing a Walking Strategy*, Dept. of the Environment Transport and the Regions, downloadable at www.local-transport.detr.gov.uk/walk/walk.htm, 1996.

Walk Tall; A Citizen's Guide to Walkable Communities, Rodale Press (Emmaus) and Pedestrian Federation of America (Washington DC; www.bikefed.org), 1995.

WSDOT, *Pedestrian Facilities Guidebook: Incorporating Pedestrians Into Washington's Transportation System*, Washington State Department of Transportation (Olympia; www.wsdot.wa.gov/ta/t2/t2pubs.htm), 1997.

WSDOT Pedestrian website (www.wsdot.wa.gov/hlrd/Sub-defaults/Pedestrian-default.htm) provides extensive information.

5. Pedestrian Safety Programs

Pedestrian safety training is particularly important for children. A number of resources are now available to assist parents, teachers, and traffic agencies develop suitable programs based on a realistic appreciation of children's learning and behavior comprehension.

Resources

Pedestrian Education for Children

Khaled Abbas, Ibrahim Mabrouk, and Khaled El-Araby, "School Children as Pedestrians in Cairo: Proxies for Improving Road Safety," *Journal of Transport Engineering*, July/Aug. 1996, pp. 291-299.

Marvin Aoki and Lawrence Moore, "KIDSAFE: A Young Pedestrian Safety Study," *ITE Journal*, Sept. 1996, pp. 36-45.

Children on the Move site on children and transport: www.ecoplan.org/children

Mayer Hillman (editor), *Children, Transport and the Quality of Life*, Policy Studies Institute (London), 1993.

Mayer Hillman, "Foul Play for Children: A Price of Mobility," *Town and County Planning*, Oct. 1988, pp. 331-332.

Kerbcraft; Smart Strategies for Pedestrian Safety, UK Department of Environment, Transport and the Regions (www.roads.detr.gov.uk/roadsafety/rs2/kerb.pdf), 1998. A curriculum for teaching children how to cross streets where there is no traffic signal.

NHTSA, *Pedestrian Safety Toolkit*, National Highway Traffic Safety Administration (www.nhtsa.gov), 1999.

Perils for Pedestrians (www.pedestrian.org) is a cable television series promoting awareness of issues affecting pedestrian safety. Their website includes advocacy tips and links to other pedestrian organizations.

Problems of Attention and Visual Search in the Context of Child Pedestrian, Behaviour, UK DETR, (www.roads.detr.gov.uk/roadsafety/rscdr/no8/index.htm), 1999.

Pedestrian/Bicyclist Resource Kit, FHWA (www.ota.fhwa.dot.gov/walk).

Pedestrian and Bicycle Crash Analysis Tool, FHWA-RD-99-192, FHWA (202-493-3315; www.tfhrc.gov).

Ian Roberts, Robyn Norton and Binki Taua, Child Pedestrian Injury Rates, "The Importance of 'Exposure to Risk' Relating to Socioeconomic and Ethnic Differences, in Auckland, New Zealand," *Health, Journal of Epidemiol Community*, Vol. 50, 1996, pp. 162-165.

R.A. Schieber and N.J. Thompson, "Developmental risk factors for childhood pedestrian injuries" *Injury Prevention*, Vol. 2, 1996, pp. 228-236.

Speed Kills, The Benefits of Slower Speeds, and *Why Reduce Speeds*, UK Anti-speed Campaign (www.speed-campaign-info.fsnet.co.uk).

Study Addresses Safety Of Children On Their Way To And From School, CUTR, (www.cutr.eng.usf.edu/new/news_let/articles/winterB98/winterB98-1.htm), 1998.

University of North Carolina Highway Safety Research Center (www.hsrc.unc.edu).

V. Planning for Bicyclists

1. Types of Cyclists

Cyclists vary significantly in abilities, needs and preferences. Both children and less experienced or timid adult cyclists may benefit from facilities with separated right-of-way. Cycle commuters require ample secure parking as well as suitable routes that offer non-circuitous access to employment centers. Bolder commuters and serious sport cyclists often prefer riding in traffic or on highway shoulders. Bicycle planning must balance these varying demands to provide the greatest community benefits with available resources.

2. Integrating Cycling Into Roadway Planning

Cycling improvements can be integrated into roadway planning by having plans and designs reviewed by experts familiar with cyclists needs, by establishing design standards that meet cyclists needs (for example, minimum shoulder widths on highways), and by performing a Cycling Audit (see box below).

Planning Tip

Cycling Audit and Review

Cycle Audit and Review provide a framework to ensure that opportunities to encourage cycling are considered in transportation planning, and that cycling conditions are not inadvertently made worse. They provide a detailed process for evaluating roadways to identify positive and negative attributes for cycling, and to assess possible improvements to encourage more cycling. A Cycle Audit applies to a specific project, while a Cycle Review applies to existing transport infrastructure.

Information on these procedures can be found in *Guidelines on Cycle Audit and Cycle Review*, Institution of Highway and Transportation (U.K.; www.iht.org), 1998. It provides specific procedures, including model review forms, which can be used at various levels of detail.

3. Bicycle Network Planning

A cycling network should be designed to link destinations and overcome barriers and hazards to cycling in a community. All roads should be considered cycling facilities (except where cycling is specifically prohibited) and should accommodate cycling as well as possible. In addition, special cycling routes should be developed that are particularly suitable to cycling because they have lower vehicle traffic volumes and speeds, fewer hills, or are separated from vehicle traffic altogether. The cycling network should be a network of streets (a grid of 0.5 kilometres or less in urban areas) that ensure safe bicycle access to all popular destinations.

There are five major categories of bicycle facilities:

1. *Bike paths* and *trails* (Class I bicycle facilities) are entirely separated from the roadway except at infrequent intersections. These are generally "multi-use" facilities used by both bicyclists and pedestrians. These are generally "multi-use" facilities for pedestrians, and sometimes equestrians, as well as bicyclists.
2. *Bike lanes* (Class II bicycle facilities) are a portion of the road marked with a line, for use by bicyclists. They are always one-way facilities, with cyclists traveling in the same direction as motor vehicle traffic in the adjacent lane. Bike lanes often become dashed lines approaching an intersection to indicate that cyclists may shift lanes, and motor vehicles may pass through the lanes as needed for turning. Bike lanes are generally found on arterial roads and on major collectors. See the National Bicycling and Walking Study #4 (FHWA 1991) for a comparison of the merits and hazards of striped lanes, shoulders, and wide curb lanes.
3. *Bike routes* (Class III bicycle facilities) are roads particularly suitable for cycling that are marked with signs. This is typically appropriate for streets with low traffic speeds (40 km/h or less) and volumes (3,000 vehicles per day or less). This may be an opportunistic classification or may be the result of specific traffic management and traffic calming modifications. Bike routes may direct cyclists away from high speed traffic, high congestion traffic, or difficult intersection situations. "Bicycle Boulevards" are roads that have been modified with traffic management and traffic calming features to be particularly suitable for cycling. Note that a network of bike routes does not eliminate the need to make all roads safe for cycling.
4. *Other roadway improvements* for cyclists include wide, paved shoulders for use in rural areas, level joints and utility covers, safe drain grates, prompt and smooth repairs, smooth railroad track crossings, bicycle sensitive traffic sensors, frequent sweeping and debris cleanup, high traction paint for roadway markings, etc.
5. *Destination facilities* include parking facilities, showers and clothes lockers.

Some people prefer "segregated" facilities, such as bike paths and trails. They consider such facilities to be more pleasant and safer to use. Many people cite the lack of such facilities as a major barrier to increased cycling. Others prefer "integrated" facilities, such as bike lanes, bike routes, and roadway improvements for their more complete access to destinations and because they are generally suitable for faster riding.[40] Segregated facilities sometimes have *higher* crash rates if they create confusion at intersections or have inadequate designs, and because cyclists must share trails with pedestrians, playing children, and leashed or uncontrolled pets. Both bike lanes and wide curb lanes must be properly designed to insure safety.[41]

Paths and trails can often be developed on available rights-of-way along waterways, abandoned railroad lines, open space at new developments, and greenbelts. These can help create a network that satisfies a range of cyclists' preferences.

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[40] John Forester, *Effective Cycling*, MIT Press, 1993.

[41] W.W. Hunter, et al, *Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations*, Turner-Fairbank Highway Research Center (www.tfhrc.gov), 1999.

Sometimes multi-lane arterials can be restriped to provide more space for cyclists in the curb lane, by narrowing the inner lanes.[42] This will allow capacity to increase by the amount of cycling added without decreasing the capacity due to slower moving cyclist.

Sidewalks are generally unsuitable to be used as bikeways for the following reasons:

- Sidewalks are generally not designed for cycling speeds. Cyclists must either reduce their speed or travel too fast for conditions.
- There is generally insufficient width for shared bicycle and pedestrian travel, particularly due to obstacles such as utility poles, signs, and street furniture that narrows the effective width of the sidewalk.
- Bicyclists face conflicts with motor vehicles at driveways and intersections. Motorists are generally not expecting a cyclist to cross their path from the sidewalk, and may not be looking for them.
- Traffic rules, such as obligations to yield, are unclear when cyclists ride on sidewalks, creating confusion and risk between pedestrians, cyclists, and motorists.

Sidewalk cycling may be safe for supervised children in uncrowded areas riding at walking speeds, but becomes increasingly hazardous as speed is increased and as crossing traffic increases in driveways and intersections.

Most communities should probably develop a range of facilities to meet the demands for the various types of cycling opportunities. A primary effort should be made to insure that all roads are safe for cycling and to create attractive routes in, or parallel to, major travel corridors. For example, even if a separated path provides cycle access to a college or employment center, it is also important to accommodate cycling on access roads for those who ride too fast for multi-use trails, and for cyclists arriving from directions that are most directly reached by the road. Similarly, some cyclists may sometimes prefer a faster, more direct route, although it has more hills or traffic, while at other times take a longer route which is flatter or has less traffic. Communities should strive to have at least some bicycle facilities that are particularly attractive, such as through a park or along a shoreline, for recreational cycling.

A bicycle facility plan should include maintenance standards that apply to trails, paths, bike lanes, and all roads. For example, it may specify the types of stormwater grates that will be installed in the future, and pavement maintenance standards that will apply to roads and road shoulders.

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[42] Dan Burden and Peter Lagerwey, *Road Diets; Fixing the Big Roads*, Walkable Communities (www.walkable.com), 1999.

4. Accommodating Cyclists on Rural Roads

Many highway agencies and local governments now specify that all highways and arterials without curbs have a smooth shoulder of 1-3 metres wherever possible, in part to more safely accommodate cyclists.[43] Shoulder pavements also make roads more convenient and safer for motorists, increase highway capacity, facilitate maintenance, snow removal, and help extend roadway life by reducing edge deterioration.[44]

Gravel roads and driveways connecting to a highway should be paved at least 4.5 metres (15 feet) back to minimize loose gravel from spilling onto the shoulder.

Table 7 **Highway Bikeway Width By Traffic Volume (Metres)**[45]

	ADT < 250	ADT 250-400	ADT 400-DHV 100	DHV 100-200	DHV 200-400	DHV >400
Rural Arterials	1.2	1.2	1.8	1.8	2.4	2.4
Rural Collectors	0.6	0.6	1.2	1.8	2.4	2.4
Rural Local Routes	0.6	0.6	1.2	1.8	1.8	2.4

ADT = Average Daily Traffic DHV = Design Hour Volume

Table 7 summarizes recommended shoulder bikelane widths. Extra width is required on steep grades and where there is a curb. A bikeway of 1.5-1.8 metre width is needed under such conditions. On shoulder widening projects there may be opportunities to save money by reducing the thickness of aggregate (50-75 mm) and asphalt (100 mm) if:

- There are no planned roadway widening projects for the road section in the foreseeable future.
- The existing road shoulder area and roadbed are stable and there is adequate drainage.
- Existing travel lanes have adequate width and are in stable condition.
- The horizontal curvature is not excessive, so wheels of large trucks do not track onto the shoulder.
- The existing and projected vehicle traffic volumes and truck traffic are not excessive.

Design Tip

If rumble strips (raised or grooved markings at the edge of the road to alert motorists running off the roadway) are installed along highways, it is important to provide adequate smooth, paved shoulder beyond the rumble strips to accommodate cyclists.[46] A good design is to have 400 mm grooves cut into the shoulder 150 mm to the right of the fog line (the white line at the edge of the road), leaving at least 1.8 m of smooth shoulder for cyclists.

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[43] Implementing Bicycle Improvements at the Local Level, ITE, FHWA (available online at www.bikefed.org/local.htm), 1998. A.M. Khan and A. Bacchus, "Bicycle Use of Highway Shoulders," Transportation Research Record 1502, 1995, pp. 8-21.

[44] Michael Ronkin, *Reasons for Highway Shoulders*, Oregon DOT (available at www.walkable.org).

[45] *Oregon DOT Highway Design Manual*, ODOT (www.odot.state.or.us/techserv/bikewalk).

[46] P. Garder, "Rumble Strips or Not Along Wide Shoulders Designated for Bicycle Traffic," *Transportation Research Record 1502*, TRB (www4.nationalacademies.org/trb), 1995, pp. 1-7.

5. Bicycle Boulevards

Bicycle Boulevards are designated bicycle routes on urban and suburban streets that use traffic management and traffic calming strategies to control motor vehicle traffic while allowing good mobility for cyclists and pedestrians. For example, a Bicycle Boulevard may be a residential street with barriers every five or six blocks that restrict or severely limit motor vehicle traffic but allow bicycles and pedestrians to easily pass. Traffic speeds are typically reduced to about 25 kilometres per hour through speed limits and traffic calming. Motorists still have full access along the street, but cannot use it for through passage. The Bicycle Boulevard has priority at intersections with most cross streets.

6. Bicycle Parking Facilities

Bicycle parking is an important part of a bicycle plan as it provides security for bicycle users at their destinations.

- Long-term (Class I) parking is needed at residences, employment centers, schools, and transportation terminals to safely store bicycles for several hours or days at a time. It must be fully protected from the weather, and enclosed in a secure space. This includes lockers, storage rooms, or fenced areas with restricted access.
- Short-term (Class II) parking is needed at commercial and recreation centers. It should be as accessible (close to destinations) as possible. At least some short-term bicycle parking should be protected from the weather (a portion can be unprotected, since demand tends to increase during dry weather), and it should be visible to by-passers to discourage theft. Bike racks should support the frame of the bike and provide something to lock the frame and wheels.

Bicycle racks and lockers must be well anchored to the ground to avoid vandalism and theft. They should be located where cycles already parked, or where recommended by bicycle advisory groups. Signs may be needed to indicate bike rack location. The following factors should be considered when locating bike parking facilities:

- **Visibility** – Racks should be highly visible so cyclists can spot them immediately when they arrive from the street. A visible location also discourages theft and vandalism.
- **Security** – Adequate lighting and surveillance is essential for the security of the bicycles and the users.
- **Weather Protection** – Where possible to protect bicycle parking from the weather. It is recommended to use an existing overhang or covered walkway, or construct a freestanding roof. Clearance of at least 2 meters is recommended.
- **Adequate Clearance** – Racks should be located so that parked bicycles do not block the pedestrian path. Adequate clearance around the racks is required, to give pedestrian clearance, and clearance from the curb or parked cars. Racks should not be placed at loading areas, near a fire hydrant, and should not block building entrances or obscure sight lines.

Table 8 **Example of Bicycle Parking Requirements**

Land Use	Bicycle Spaces Required	Type
RESIDENTIAL		
Single family / two family	N/A	N/A
Apartment / Townhouse	1 per unit plus 6 space rack at each building entrance.	Class I 100% Class II 6 space rack
COMERCIAL		
Hotel / Motel	1 per 15 rooms. In addition, when hotel/motel is greater than 75 rooms, a 6 space visitor rack shall be provided	Class I 60% Class II 40%
Office, retail sales of goods and services, restaurants, research establishments, laboratories	1 per 250 m^2 GFA for the first 5000 m^2 and 1 per 500 m^2 for any additional area	Class I 50% Class II 50%
Shopping Centre	1 per 250 m^2 of gross leasable area for the first 3000 m^2 and 1 per 500 m^2 of gross leasable area for any additional area.	Class I 30% Class II 70%
INDUSTRIAL (ALL)	1 per 950 m^2 GFA	Class I 80% Class II 20%
INSTITUTIONAL		
Hospitals	1 per 500 m^2	Class I 75% Class II 25%
Schools	All levels: 1 per 10 employees	Class I employees college, university 10% Class II students
Elementary	1 per 10 students	
Junior Secondary	1 per 8 students	
Senior Secondary	1 per 8 students	
College	1 per 5 students	
University	1 per 5 students (full time, max. attendance)	
Churches	1 per 50 members	Class II 100%
Library / Museum/ Art Gallery	a per 100 m^2 GFA	Class I 20% Class II 80%
Personal Care / Nursing Home / Group Home	1 per 15 dwelling units	Class I 75% Class II 25%
Correctional Institutions	1 per 50 beds	Class I 70% Class II 30%
CULTURAL AND RECREATIONAL		
Community Centre	1 per 80 m^2 of GFA	Class I 20% Class II 80%
Stadium, Arena, Pool, Exhibition Hall, similar places with spectator facilities	1 per 100 m^2 of surface area	Class I 20% Class II 80%
Gymnasium, Health Spa	1 per 80 m^2 of surface area	Class I 20% Class II 80%
Bowling Alley, Curling Rink	1 per 2 alleys or sheets	Class I 20% Class II 80%

Class I bicycle parking provides complete protection for a bicycle and equipment. Class II facilities are racks that a bicycle can be securely locked to.

Resources

Bicycle Parking Facilities

Bicycle Coalition of Massachusetts bicycle parking information, providing bicycle parking bylaws and manufactures contacts (www.users.thecia.net/users/bcom/lawlegis/parking.htm).

Bicycle Parking Facilities Guidelines, City of Portland (www.trans.ci.portland.or.us/Traffic_Management/Bicycle_Program/parkguide.htm)

7. Integrating Cycling and Transit

Bicycling and public transit (including bus, rail, ferry, and even air transport) work well together. Transit is effective for moderate- and long-distance trips along busy corridors, while cycling is effective for shorter-distance trips with multiple stops. Integrating transit and cycling can provide a high level of mobility. The combination of cycling and public transit often replaces trips that could otherwise only be made by automobile. It also allows cyclists to pass major barriers, such as tunnels or freeways where cycling is prohibited, or particularly difficult.

Bike-and-ride facilities can increase the efficiency of public transit services by expanding the catchment area. A transit stop normally draws pedestrians within a 10-minute walk, or 400 meters. Cyclists can cover three to four times the distance in the same time, increasing the catchment area by about ten-fold. Bicycling can also benefit drivers using park-and-ride facilities by freeing up vehicle spaces. Bicycle and transit integration has proven successful in attracting new riders. For example, 30% of users of Vancouver's bike lockers at a transit station had not previously used public transit to commute.[47]

One step to achieving this objective is to provide bike parking at transit stops and terminals. A high level of security (Type I bike storage) is required by many commuters, for storing a bicycle at inter-city bus or ferry terminals. Some cyclists may only require Type II bike storage (simple racks), particularly in areas with minimal security problems. Table 9 shows typical costs for bicycle and automobile parking.

Table 9 **Park-and-Ride and Bike-and-Ride Facility Comparison**[48]

Characteristic	Park-and-Ride	Bike-and-Ride
Land requirements (m2)	30	1-2
Installation cost per space	$10,000 - $12,000	$140 - $800
Operating cost per space (year)	$110	$0 - $30

Another approach is to accommodate bicycles on transit vehicles. This allows a bicycle to be used at both ends of the journey, and provides an option when cyclist cannot ride due to a mechanical failure, changes in weather, or other any other reason. Many public transit agencies have installed special racks to carry bicycles on buses, or have policies that allow bicycles to be carried as luggage or within vehicles during off-peak periods.

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[47] Planning and Marketing Division, *Bicycle Locker Demonstration Program*, BC Transit (Vancouver), 1992, p. 5.

[48] M. Replogle and H Parcells, *Linking Bicycle/Pedestrian Facilities with Transit*, U.S. Federal Highway Administration (Washington DC), 1992, pp. 84-88.

Resources

Transit and Bicycle Integration

Bicycles & Transit; A Partnership That Works, Federal Transit Administration (www.fta.doc.gov).

Bike Racks On All Metro Buses (http://transit.metrokc.gov/bike/bikeride.html). Describes bike rack program in Seattle area.

Michelle DeRobertis and Rhonda Rae, "Buses and Bicycles: Design Alternatives for Sharing the Road," *ITE Journal*, Vol. 71, No. 5 (www.ite.org), May 2001, pp. 36-44.

Planning and Marketing Division, *Bicycle Locker Demonstration Program*, BC Transit (Vancouver), 1992.

Michael Replogle and Harriet Purcells, *Linking Bicycle/Pedestrian Facilities with Transit, National Bicycle and Walking Study, Case Study No. 9*, FHWA, (Washington DC; www.bikefed.org), 1992.

Steve Spindler and John Boyle, "Bikes on Transit" (www.bikemap.com/trans.html), 1999. Website lists transit agencies that accommodate bicycling.

"Taking Bikes on Bay Area Transit" (www.transitinfo.org/Bikes/bike.html), 1999. Website provides information on the requirements and rules for carrying bicycles on transit vehicles by various San Francisco Bay area transit agencies.

Transit Cooperative Research Program *TCRP Synthesis 4, Integration of Bicycles and Transit*, Transportation Research Board (www4.nationalacademies.org/trb/homepage.nsf), 1994.

Toronto Transit Commission (1994) *TTC Bike and Ride Study Final Report*, Toronto, Ontario.

8. Roadway Maintenance for Cyclists

Since most cycling occurs on public roads, roadway maintenance is an important part of accommodating cycling. Below are some types of targeted maintenance.[49]

- *Surface Repairs* – Inspect bikeways and road shoulders regularly for surface irregularities, such as potholes, pavement gaps or ridges. Such hazards should be repaired quickly.
- *Sweeping* - Establish a sweeping schedule. Sweeping road shoulders of accumulated sand and gravel in the springtime, and fallen leaves in the autumn where they accumulate. Sweepings should be picked up rather than just pushed aside in areas with curbs. Driveway approaches may be paved to reduce loose gravel on paved roadway shoulders.
- *Pavement Overlays* – Where new pavement is installed, extend the overlay to the edge of the roadway. If this is not possible, ensure that no ridge remains at the edge of the road shoulder or bike lane. Do not leave a ridge within the bike travel area. Drain grates should be within 6 millimetres of the pavement height to create a smooth travel surface. Special attention should be given to ensure that utility covers and other road hardware are flush with new pavement.
- *Rail Crossings* – Rail crossings can be hazardous to cyclists, particularly if they are at an oblique angle. Warning signs and extra space at the road shoulder can allow cyclists to cross at a 90º angle. A special smooth concrete apron or rubber flange may be justified at some crossings.
- *Vegetation* – Vegetation may impede sight lines, or roots may break up the travel surface. Vegetation should be cut back to ensure adequate sight lines, and invasive tree roots may be cut back to preserve the travel surface.
- *Street Markings* – bike lane markings signal loop indicators may become hard to see over time. These should be inspected regularly and retraced when necessary.
- *Snow removal* – Road plowing should extend into the lane space used by cyclists. Spot salting intersections often creates a hazardous icy patch just past the melted intersection. Trails that get significant winter cycling should be plowed unless they are relegated to ski/snowshoe users.
- *Roadway Markings* – Whenever roadway markings are used, traction or non-skid paint should be used to avoid the markings becoming slippery in wet weather.

[49] *Implementing Bicycle Improvements at the Local Level*, ITE, FHWA (available online at www.bikefed.org/local.htm), 1998.

Resources

Bicycle Planning

AASHTO, *Guide for the Development of Bicycle Facilities, 3rd Edition*, American Association of State Highway and Transportation Officials (www.aashto.org), 1999.

The **Bicycle Federation of America** (Washington DC; 202-463-6625; www.bikefed.org) provides extensive resources for bicycle and pedestrian planning.

CIP, *Community Cycling Manual*, Canadian Institute of Planners (www.cip-icu.ca), 1999, available through Go For Green (www.goforgreen.ca).

The **Community Bicycle Network** (CBN) Factsheets, newsletter, curriculum guides, and action manuals, Detour Publications (www.web.net/~detour/cbn).

Guidelines on Cycle Audit and Cycle Review, IHT (www.iht.org), 1998.

John Forester, *Bicycle Transportation: A Handbook for Cycling Transportation Engineers*, MIT Press, 1994. A comprehensive guide written by an advocate of integrated cycle planning.

William Hunter, et al, *Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations*, FHWA, FHWA-RD-99-035 (www.tfhrc.gov), 1999.

Implementing Bicycle Improvements at the Local Level, ITE, Federal Highway Administration (available online at www.bikefed.org/local.htm), 1998.

National Bicycle and Walking Study (24 volumes), FHWA, (Washington DC; www.bikefed.org/local.htm), 1991-95.

National Highway Traffic Safety Administration (www.nhtsa.dot.gov) has safety resources.

Northwestern University Traffic Institute (Evanston, Illinois; 800-323-4011; www.nwu.edu/traffic) offers bicycle planning and facility design workshops.

Oregon **DOT Bicycle and Pedestrian Planning** (www.odot.state.or.us/techserv/bikewalk/obpplan.htm) shows nonmotorized planning at its best.

The **Bicycle Information Center** (www.bicyclinginfo.org) provides information on nonmotorized transport planning and programs.

Pedestrian/Bicyclist Resource Kit, FHWA (www.ota.fhwa.dot.gov/walk).

Suzan Anderson Pinsof and Terri Musser, *Bicycle Facility Planning*, Planners Advisory Service, American Planning Association (Chicago; 312-786-6344), 1995.

SWOV, *Best Practice to Promote Cycling and Walking*, Denmark Ministry of Transport (vd@vd.dk), European Commission Directorate General of Transport, 1998.

TAC, *Bikeway Traffic Control Guidelines*, Transportation Association of Canada (Ottawa; 613-736-1350; www.tac-atc.ca), 1999.

University of North Carolina Highway Safety Research Center (www.hsrc.unc.edu).

John Williams, Bruce Burgess, Peter Moe and Bill Wilkinson, *Implementing Bicycle Improvements at the Local Level*, FHWA, Report FHWA-RD-98-105, 1998.

The WSDOT Bicycle website (www.wsdot.wa.gov/hlrd/Sub-defaults/Bicycle-default.htm) has information and examples of Washington's outstanding bicycle planning programs.

VI. Safety Programs

Bicycle and pedestrian safety programs can help reduce the risk of crashes and injuries.

1. Safety Education

Education of pedestrians, cyclists and motorists is essential for non-motorists' safety and mobility. This can be one of the most effective and cost effective ways of reducing collisions and encouraging cycling. Excellent safety education resources are now available. A number of types of programs can be implemented:

- In-schools, pedestrian and cycling classes can be integrated with school trip management programs (reducing child auto travel to, and traffic around schools), personal safety and fitness, and physical education programs.
- Adult cycling skills classes, such as Can-Bike programs, may be taught at recreational facilities, or provided through local traffic safety associations.
- Public education campaigns targeting motorists, cyclists, and pedestrians covering cyclists and pedestrians rights and safety skills (such as Go Green's "Share the Road" campaigns).

Although many communities have some programs, few communities have enough pedestrian and cycling programs to educate a significant portion of the population. Responsibility for such programs is fragmented, and there is seldom stable funding.

Resources

Safety Education

Bike Smarts (Vancouver; 800-565-7727; 604-738-2468; jwsporta@mindlink.bc.ca) provides resources for training cycling safety skills to children 7-13 years old.

Canadian Cycling Association (Gloucester, Ontario; www.canadian-cycling.com) manages the Can-Bike cycling education program.

Anne Fritzel, *Smart Moves for Washington Schools*, Climate Solutions (www.climatesolutions.org), 2000.

HSRC (Highway Safety Research Center, University of North Carolina), *Pedestrian and Bicycle Crash Analysis Tool* (PBCAT), Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA), available free from the Pedestrian and Bicycle Information Center (www.walkinginfo.org), 2000. This is a crash typing software product intended to assist development of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists.

League of American Bicyclists Education Programs (www.bikeleague.org/ec2/education.htm) provides a variety of resources.

Way To Go! School Program, "small steps towards a big difference," (Vancouver; 1-877-325-3636; www.waytogo.icbc.bc.ca) provides a variety of safety education strategies and materials, and information on increasing walking and cycling to school.

Marcus R. Wigan, "Using Geographic Information Systems to Promote Vulnerable Road User Safety Education," Conference on Road Safety, *Proceedings*, Australian College of Road Safety, Canberra, 1998, pp. 67-76.

2. Traffic Law Enforcement

Appropriate traffic law enforcement can prevent conflicts and collisions, and help instill lifelong traffic safety habits in young people. A teenager who has spent years violating bicycle traffic laws with impunity is being poorly prepared to become a responsible car driver. Safety experts recommend targeting the following cycle traffic violations:

- Motorist's failure to yield or stop for pedestrians and cyclists when required by traffic law.
- Excessive motor vehicle speed.
- Intoxicated driver and cyclists.
- Cyclist's failure to yield when required by traffic law.
- Cyclist riding in the wrong direction, against traffic.
- Cyclists riding at night with inadequate lighting.

Effective enforcement requires overcoming various barriers. Nonmotorized traffic violations, particularly by children, are often considered a low priority by police and the community. Standard traffic fines may appear excessive. Cyclists and pedestrians may ignore citations unless police departments develop a suitable processing system.

A bicycle "diversion" program allows offending cyclists to take a cycling safety workshop as an alternative to paying a traffic fine (i.e., they are "diverted" from the court system). Police departments can run such workshops internally or contract with an outside expert. Such programs are popular because they emphasize safety rather than punishment, and help develop cooperation among police, parents, and bicycle safety advocates. Scout troops, school groups, and parents often attend the safety workshops voluntarily. Here's how such programs typically work:

- Cyclist is ticketed for violating a traffic law.
- If the cyclist is a child, police send a standard letter to their parents describing the violation, emphasizing the importance of observing bicycle traffic laws for the sake of safety, asking the parent to bring the child to a bicycle safety workshop (typically offered monthly or semi-monthly) within a specified time period (such as three months), and inviting the parent to contact the program coordinator if they have any questions.
- If the cyclist attends the workshop the traffic ticket is void and destroyed.
- If the cyclist fails to attend the workshop in the specified period, the ticket is processed.
- Police and courts coordinate to allow efficient processing of cyclist traffic tickets.

Resources

Bicycle Law Enforcement

NHTSA, *Resource Guide on Laws Related to Pedestrian and Bicycle Safety*, The National Highway Traffic Safety Administration (www.nhtsa.dot.gov/people/injury/research/ResourceGuide/index.html), contains a compilation of U.S. vehicle and traffic laws that affect walking or cycling.

International Police Mountain Bike Association (www.ipmba.org) is an organization of police officers who use bicycles for patrol.

VII. Encouragement and Promotion

Increased nonmotorized transportation can help achieve Transportation Demand Management (TDM) objectives, and provides other community benefits including improved public health, and local economic development. There are a number of strategies to help encourage and promote walking and bicycling to support these objectives. Examples include:

- Transportation demand management programs, such as parking cash out (giving commuters who don't drive to work the cash equivalent of parking subsidies provided to drivers), which provide financial incentives to use travel alternatives such as walking and cycling.
- Parks, recreational programs, or non-profit groups can sponsor walking and cycling events and activities, particularly on trails and cycling routes.
- Tourist promotion materials can highlight walking and cycling.
- Special bicycle events can raise the profile of cycling in the community. Bike to Work Week (usually held in June) offers commuters an opportunity to try cycling. The event may include special publicity, special guidance to first-time bicycle commuters on choosing a route, or special breakfasts for bicycle commuters. Bike to Work Week events have been held in many BC communities for several years.

Bike Maps

A bicycle map can be published which shows cycling facilities, recommended routes, roadway conditions (shoulders, traffic volumes, special barriers to cycling, etc.) hills, recreational facilities, and bicycle shops to help potential cyclists identify their best routes.

Resources

Bicycle Encouragement and Transportation Demand Management

ADONIS, *Best Practice to Promote Cycling and Walking*, Cordis Transport Program (www.cordis.lu/transport/src/adonisrep.htm), 1999.

Association for Commuter Transportation (Washington DC; 202-393-3497, fax: 202-347-8847; http://tmi.cob.fsu.edu/act/act.htm) is a non-profit organization supporting TDM programs.

BEST – Better Environmentally Sound Transportation (Vancouver; 604-669-2860; www.sustainability.com/best) provides resources to promote transportation alternatives.

Center for Urban Transportation Research, USF (Tampa; http://cutr.eng.usf.edu). Provides TDM materials and classes. Publishes *TMA Clearinghouse Quarterly.*

J. Cleary and Hugh McClintock, "Evaluation of the Cycle Challenge Project, *Transport Policy*, Vol. 7, No. 2, April 2000, pp. 117-125.

Commuter Choice Program (www.epa.gov/oms/traq) provides information, materials and incentives for developing employee commute trip reduction programs.

Environment Canada "Green Lane" program (www.ec.gc.ca/emission/5-1e.html) promotes TDM and other strategies for reducing transportation environmental impacts.

Anne Fritzel, *Smart Moves for Washington Schools*, Climate Solutions (www.climatesolutions.org), 2000.

Go For Green, The Active Living & Environment Program (www.goforgree.ca) provides resources to promote nonmotorized transportation.

The *Institute of Transportation Engineers* (Washington DC; www.ite.org) has extensive technical resources on TDM, transportation planning, and traffic calming.

UK Health Education Authority (www.hea.org.uk) has excellent material to promote "transport exercise" and better integration of nonmotorized transport in public health programs.

Joseph Milazzo, et al., *Quality of Service for Interrupted Pedestrian Facilities in the 2000 Highway Capacity Manual*, Transportation Research Board Annual Meeting, 1999.

Lawrence Frank and Peter Engelke, *How Land Use and Transportation Systems Impact Public Health*, Active Community Environments, Center for Disease Control (www.cdc.gov), 2000.

SWOV, *Best Practice to Promote Cycling and Walking*, Denmark Ministry of Transport (vd@vd.dk), European Commission Directorate General of Transport, 1998.

Transportation Association of Canada (Ottawa; www.tac-atc.ca) provides a variety of resources related to transportation planning and TDM.

Washington Department of Transportation, TDM Resource Center (Seattle; 206-464-6145; fax: 206-464-6084; www.wsdot.wa.gov) and Northwest Technology Transfer Center (Olympia; www.wsdot.wa.gov/TA/T2/publications.html) offer a variety of resources for TDM planning.

Victoria Transport Policy Institute (www.vtpi.org) provides resources for planning and evaluating TDM, bicycling, and walking programs.

VIII. Implementation Strategies and Tools

Various planning strategies and tools used to implement pedestrian and bicycle plans are described in this section.

1. Comprehensive Plans

U.S. Metropolitan Planning Organizations (MPOs) are required to develop long-range (20-25 year) Regional Transportation Plans, and a five-year Transportation Implementation Plan (TIP) to quality for federal transportation funds. These plans are required to take into account safety and security for nonmotorized travel, accessibility, environmental and quality of life impacts on a community.

A community Comprehensive Plan is a statement of the policy direction of a municipal council that provides a vision, goals, and performance measures. It is an opportunity to integrate pedestrian and cycling improvements into community projects and activities. Specific components that may support nonmotorized travel include:

- Goals to increase mobility choices and encourage alternatives to automobile travel.
- Specific objectives for modal split, facility use, and increased road safety.
- Policies to review transportation projects and incorporate consideration of bicycle and pedestrian travel where appropriate.
- Specific objectives for making roadways compatible to walking and cycling.
- Land use and development codes that accommodate and encourage nonmotorized travel.

2. Road Design, Reconstruction and Maintenance Requirements

As roads are redesigned or reconstructed, there are often opportunities to better accommodate bicycle and pedestrian travel at minimal cost. Engineering policies and staff knowledge can be improved to ensure better consideration of cyclist and pedestrian needs. [50] Examples include:

- Policies to ensure that pedestrian and cycling facilities will be given high priority in new construction and rehabilitation.
- The adoption of current standards for the design of pedestrian and cycling facilities incorporated into roadway projects (such as AASHTO standards).
- Policies that increase right-of-way for bicycle and pedestrian facilities when appropriate.
- Polices that provide sufficiently wide curb lanes and paved road shoulders to accommodate cyclists on new and reconstructed arterials and highways.
- The training of planning and engineering staff in pedestrian and cycling design.
- Traffic management and traffic calming programs.
- Repair and maintenance programs that provide adequate surface quality for road shoulders, railroad crossings, and storm drain grates that are safe for cyclists, traffic signal sensors that recognize cyclists, and high standards for pedestrian crossings.

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[50] *Guidelines for Cycle Audit and Cycle Review*, Institution of Highway and Transportation (London; www.iht.org), 1996.

3. Municipal Laws

Municipal by-laws regulate the actions of residents of the municipality. Bylaws can be changed to provide more safety for nonmotorized travel, and to establish development and design standards that consider pedestrian and cycling needs. For example, bylaws may:

- Require citizens to clear snow and trim trees along sidewalks on their property.
- Require construction companies to provide safe and well-signed alternate pedestrian and bicycle routes when construction occurs on walkways and roads.
- Allow child cyclists to ride on sidewalks, provided they yield to pedestrians. Note: While not ideal, children generally travel at low speeds and do not have the skills to deal with traffic on the roads.
- Require bicycle parking and allow reductions in automobile parking requirements where walking and cycling are likely to reduce vehicle use.
- Require adequate pedestrian facilities in new developments, such as sidewalks on both sides of streets, and public paths that connect the ends of new cul de sac streets.
- Specify road and parking facility designs that accommodate walking and cycling, and control vehicle traffic volumes and speeds where appropriate (see sections below on "traffic calming" and "livable community" for specific design guidelines).

4. Major Projects and Site Plan Agreements

If major urban infrastructure is planned, construction and development guidelines should ensure that opportunities to provide bicycle and pedestrian infrastructure are considered. For example, work on a public utility right-of-way may provide an opportunity for a new path, or improvements to a bridge may allow pedestrian facilities to be widened at minimal cost.

Development proposals for residential, commercial, and industrial projects often involve site plan agreements. The agreements provide the ideal opportunity to negotiate the inclusion of bicycle and pedestrian facilities into the overall design.

Development standards can incorporate "traffic calming" and "livable community" strategies, described below. This includes land use planning that provides convenient pedestrian and cycling access to common destinations, "modified grid" street patterns, relatively narrow street widths, reduced off-street parking requirements, and traffic calming strategies.

5. Working with Neighborhood and Business Associations

Residential neighborhood and business associations may support pedestrian and bicycle improvements as part of efforts to improve their local street environments. They may be particularly interested in sidewalk improvements and traffic calming. These groups should be consulted to help identify and prioritize problems and concerns related to nonmotorized planning.

Planning departments can establish a process that residents and businesses on a particular street can use to request and fund such improvements.[51] For example, this may include a list describing acceptable traffic calming strategies and pedestrian improvements, a requirement that 60% of residents or business owners sign a petition requesting such improvements before they will be considered for implementation, and funding options that may include local improvement districts (LIDs), by which property owners in the area pay a special fee to fund the project.

In some cases, neighborhood and business associations can provide sponsorships or matching funds, contribute in-kind goods and services, or volunteer labor for implementing improvements, or take responsibility for landscaping and maintenance. For example, the city of Seattle relies on residents to provide landscaping at more than 700 traffic circles that have been installed on local streets.

6. Land Exchange, Dedication of Parkland with Private Developer

Often, developers or landowners are willing to trade part or all of their land for a more favorable site. In this way, municipalities can acquire lands that can be used for the development of bicycle and pedestrian facilities. Many municipal governments require the dedication of parkland either in the form of land deeded to the municipality or as cash in lieu. This dedication can potentially be used to provide bicycle and pedestrian facilities and linear parks. On a smaller scale, to provide pedestrian access to an adjacent street from the end of a cul de sac, the city may buy a suitable property when it comes onto the market, subdivide to provide a pedestrian right of way, develop a walkway and resell the property.

7. Rural Areas, Utility Corridors, Fire Roads and Rails-to-Trail Opportunities

Special agreements may be negotiated between government agencies and private organizations for permission to use utility corridors, fire roads, or railway beds for bicycle and pedestrian facilities. Abandoned rail line and other right of way may be obtained by purchase or through agreements with landowners.

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[51] For a good example see *Making Streets That Work; Neighborhood Planning Tool*, Engineering Dept., City of Seattle (www.ci.seattle.wa.us/npo/tblis.htm), 1996.

IX. Related Planning Issues

This section describes a number of specific planning issues that closely relate to nonmotorized transportation planning.

1. School Trip Management

School trips are often made by walking and cycling, and so deserve special attention in nonmotorized transportation planning. But this can only occur if school sites are selected and designed for pedestrian access. A study in South Carolina found that the portion of students walking to school is far higher in older (pre-1970) schools than in schools that were built recently because the newer schools tend to be located at the urban fringe.[52] An access plan should be developed for every major educational facility, from grade schools to universities, which addresses constraints and problems to nonmotorized travel.

In recent years, an increasing portion of school trips have been made by automobile. This creates a number of problems, including traffic congestion, parking, and neighborhood disruption problems around schools, reduced exercise for children, and environmental impacts. The resulting vehicle congestion and increased collision risk further degrades conditions for nonmotorized modes, encouraging even more driving. Some schools now encourage the use of "active" (i.e., walking and cycling) modes in order to:

- Increase physical activity and exercise.
- Encourage healthier lifestyle habits.
- Reduce congestion and parking problems around schools.
- Create safer and calmer streets and neighborhoods.
- Protect the environment.

Resources

School Trip Management

"Active and Safe Routes to School" (Ottawa; 888-UB-ACTIV; 613-562-531; www.goforgreen.ca) is a Canada-wide program to encourage the use of active modes of transportation to and from school.

Ministry of Transportation and Highways, *Safe Crossings: Guidelines for School Crossing Programs*, Road Safety Program, ICBC (Vancouver; 604-661-6643; www.icbc.com), 1998.

Joseph P. Savage, et al., *A Guidebook for Student Pedestrian Safety*, Washington State Department of Transportation (Olympia; www.wsdot.wa.gov/ta/t2/t2pubs.htm) 1996.

SUSTRANS Safe Routes to School Project (www.sustrans.co.uk/srts) is a demonstration project in the United Kingdom to show how children can be encouraged to cycle and walk to school.

School Travel, School Travel Advisory Group, (www.local-transport.detr.gov.uk/schooltravel), 1999.

Way To Go! School Program, "small steps towards a big difference," (Vancouver; 1-877-325-3636; www.waytogo.icbc.bc.ca) provides resources and support for school traffic reduction programs, including a variety of safety education strategies and materials.

[52] *Waiting for the Bus: How Lowcountry School Site Selection and Design Deter Walking to School*, Southern Carolina Coastal Conservation League (Charleston), 1999.

2. Traffic Management and Traffic Calming

Traffic management includes strategies to control the amount of traffic on particular streets, including street layout, traffic routing, and traffic control devices. *Traffic calming* is the name for road design strategies specifically intended to reduce vehicle speeds and volumes.

Traffic management and traffic calming programs are often a critical component of pedestrian and bicycle planning. Virtually any traffic calming measure enhances the pedestrian environment by reducing traffic speeds and volumes. Traffic calming can be used to create a network of streets that encourage cycling. When traffic volumes and speeds are sufficiently reduced, for example, through residential neighborhoods, the need for special bike lanes or separated bicycle trails is reduced.

Resources

Traffic Management and Traffic Calming

APA, *Traffic Calming* (1995), American Planning Association (www.planning.org).

Dan Burden and Peter Lagerwey, *Road Diets; Fixing the Big Roads*, Walkable Communities (www.walkable.com), 1999.

Stephen Burrington & Veronika Thiebach, *Take Back Your Streets; How to Protect Communities from Asphalt and Traffic*, Conservation Law Foundation (Boston; www.clf.org), 1995.

Congress for the New Urbanism's Narrow Streets database (www.sonic.net/abcaia/narrow.htm) provides information on narrower street standards adopted in various communities.

David Engwicht, *Street Reclaiming; Creating Livable Streets and Vibrant Communities*, New Society Publishers (www.newsociety.com), 1999. David Engwicht Communications (www.lesstraffic.com) provides information on "street reclaiming."

Institute of Transportation Engineers (Washington DC; www.ite.org) publishes a number of useful traffic calming and pedestrian planning documents. *Residential Street Design and Traffic Control*, provides detailed guidelines for neighborhood traffic management. *Traditional Neighborhood Development Street Design Guidelines,* 1997. *Traffic Calming: State of the Practice.* 1999, has a collection of case studies.

The Local Government Commission (www.lgc.org/clc/pubinfo) provides a variety of useful material including *Street Design Guidelines for Healthy Neighborhoods* by Dan Burden.

The city of Portland (www.trans.ci.portland.or.us/Traffic_Management/trafficcalming) provides excellent information and materials on traffic calming and pedestrian planning.

City of Seattle (206-684-4000, Fax: 206-684-5360; www.ci.seattle.wa.us/npo/tblis.htm) has an outstanding neighborhood planning process that includes traffic calming resources. *Making Streets that Work* is a particularly useful document

Transportation Association of Canada (Ottawa; 613-736-1350; www.tac-atc.ca) publishes the *Canadian Guide to Neighborhood Traffic Calming* and sponsors traffic calming workshops.

3. Roadway Access Management

Access management refers to coordination between roadway design and landuse planning to improve transportation. It includes the placement and design of driveways and sidestreets to minimize conflicts and hazards, and the design and location of development to improve access by different modes and minimize traffic problems.

Access management tends to reduce the number of and width of driveways and access roads on highways and arterials. This can benefit cyclists and pedestrians by reducing points of conflict and making vehicle traffic more predictable. It is also important to incorporate pedestrian and bicycle planning into access management programs to avoid problems that can result from increased traffic speeds.

Resources

Access Management

U.S. National Transportation Library, Access Management Publication (www.bts.gov/ntl/subjects/access.html).

Ohio-Kentucky-Indiana Regional Council of Governments, *Access Management: A Policy for Local Communities*, United States Department of Transportation, 1988.

Access Management Program, Oregon DOT, (www.odot.state.or.us/tdb/planning/access_mgt)

Joanne Lazarz, *Corridor Preservation And Access Management Guidance; Guidelines to Assist Metropolitan Planning Organizations in Addressing Corridor Preservation and Access Management Concerns in their Communities*, Wisconsin Department of Transportation (www.bts.gov/ntl/data/plan-policy/access/00223.html), 1994.

Land Development and Subdivision Regulations that Support Access Management, Center for Urban Transportation Research, University of South Florida (www.cutr.eng.usf.edu), 1995.

4. Livable Community Planning

Recently, there has been growing interest in efforts to create "livable communities," also called "neotraditional planning," "New Urbanism," and "sustainable community planning." It can also include "Transit Oriented Developments" and "Pedestrian Pockets," which represent the application of some of these design concepts at the neighborhood level. These incorporate a number of design features that help facilitate walking and cycling:

- A "modified grid" street system (a dense network of connected streets with many "T" intersections).
- Relatively narrow streets and short block lengths.
- Low vehicle traffic design speeds.
- Small curb radii.
- Pedestrian and bicycle facilities.
- Traffic calming strategies.

Although these represent a change from design standards used in most North American communities, they are well accepted by transportation professionals. Publications by Institute of Transportation Engineers,[53] the American Society of Civil Engineers, and the National Association of Home Builders[54] endorse such standards. For example, they recommend 22-24 ft. widths for local streets, and 26-28 ft. widths for subcollectors, rather than the 36-feet that are commonly used.

The basic unit of a livable community is a walkable neighborhood, with streets and other public spaces that encourage community interaction. Neighborhoods are clustered to form towns and cities. A variety of compatible land uses are mixed to improve access to employment, retail, and community facilities and services. An interconnected network of lower speed streets is designed for safe and pleasant walking, cycling, and driving, with consideration for transit and people with disabilities. Automobile traffic is discouraged. A mix of residential forms exists to meet diverse housing needs. Livable community designs are energy efficient and respect the natural environment. *Planning for nonmotorized transport is essential for development livable communities.*

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53 Wolfgang Homburger, et al., *Residential Street Design and Traffic Control*, ITE (Washington DC; www.ite.org), 1989.

54 *Residential Streets*, American Society of Civil Engineers, National Association of Home Builders, and the Urban Land Institute (Washington DC), 1990.

Resources

Livable Community Planning

The **American Planning Association** (www.planning.org) is a professional society for planners that sponsors a "Growing Smart" initiative and provides many useful materials.

Carfree.com (www.carfree.com) explores carfree cities past, present, and future, and provides practical solutions to the problems of urban automobile use.

Center for Livable Communities (www.lgc.org/clc) helps local governments and community leaders to be proactive in their land use and transportation planning.

Congress for New Urbanism (www.cnu.org) is a movement to develop urban communities built to a human scale.

The **International Council for Local Environmental Initiatives** (www.iclei.org) is the "international environmental agency for local governments" which provides tool to help communities become healthier and more environmentally responsible.

LMN Architects, *Model Code Provisions; Urban Streets and Subdivisions*, Washington State Community, Trade and Economic Development (Olympia; www.wsdot.wa.gov/hldr/pdf/cted.pdf)

The **National Trust for Historic Preservation** (www.nationaltrust.org) focuses on preserving downtown areas and historic buildings.

Planners Web (www.webcom.com/pcj), maintained by *Planning Commissioners Journal*, includes a sprawl resources guide, a primer for citizen planners, a tour of 12 key planning related sites, and a section on conservation design for subdivisions.

Project for Public Spaces, Inc. *Transit-Friendly Streets: Design and Traffic Management Strategies to Support Livable Communities*, TCRP Report 33, Transportation Research Board (Washington DC; www4.nationalacademies.org/trb/homepage.nsf), 1998.

Rhys Roth, *Redevelopment for Livable Communities*, WSDOT (Olympia; www.wsdot.wa.gov/ta/t2/t2pubs.htm), 1995.

The Smart Growth Network (www.smartgrowth.org) includes planners, govt. officials, lenders, community developers, architects, environmentalists and activists.

Sprawl Watch Clearinghouse (www.sprawlwatch.org) provides information, advice & referrals on sprawl & smart growth.

Sustainable Communities Network (www.sustainable.org) provides tools to help citizens work together to define a community's course and make it more sustainable.

TAC, *Achieving Livable Communities*, Transportation Association of Canada (www.tac-atc.ca), 1998.

Rodney Tolley, *The Greening of Urban Transport*, John Wiley (New York), 1997.

Transportation for Livable Communities (www.tlcnetwork.org) is a resource for people working to create more livable communities by improving transportation.

World Health Organization Healthy Cities Project (www.who.dk/london99) provides information on international efforts to create healthy cities.

Appendix 1 Model Pedestrian And Bicycle Plan

This section describes a typical municipal pedestrian and bicycle plan.

Planning Tip

Typical Plan Components

1. *Goals and objectives.* Define the outcomes that are to be achieved.
2. *Bicycle network plan.* Identifies infrastructure (trails, bike lanes, bike routes) that provides cycling access to major destinations (schools, commercial centers, intermodal terminals, and recreational areas), and connections to regional and provincial bicycle routes.
3. *Design guidelines*. This identifies specific dimensions, clearances, safety features, materials, surface treatments, signage, and pavement markings, etc., for facilities, usually based on published standards recommended by a major professional or government organization.
4. *Maintenance policies and procedures*. This includes maintenance standards and priorities, and indicates who is responsible for implementation.
5. *End-of-trip bicycle facilities* (bicycle storage racks or lockers, showers, and clothes changing facilities).
6. *Capital expenditure plan.* Identifies project costs and timing of implementation.
7. *Support programs.* Includes safety education, law enforcement, and promotion activities.
8. *Evaluation.* This includes on-going monitoring of facility use, condition, and problems.

Purpose:

- To identify needed improvements to enable and enhance walking and cycling.
- To provide standards for planning, designing and maintaining bikeways and walkways.
- To fulfill the requirements of the Growth Strategies Act.

Introduction

The development of Bicycle and Pedestrian plans is an essential component of building cycling and walking communities. This plan outlines the policies for adoption to support cycling and walking in communities. It identifies goals, objectives, and evaluation criteria for pedestrian and bicycle planning, design, education, enforcement, and encouragement. It identifies actions for municipal agencies to implement these objectives. It provides a prioritized list of bicycle and pedestrian network programs and projects, and a recommended budget to ensure the plan's implementation.

Vision:

- *Walking and bicycling provide safe and convenient access to all destinations within the City.*
- *People can walk or ride to and from their transit stops and have a comfortable and convenient place to wait or transfer.*
- *Highways, streets, roads, paths, sidewalk, transportation terminals, and land use patterns are designed to accommodate and encourage bicycling and walking.*
- *Nonmotorized travel becomes increasingly common for transportation and recreation.*
- *Appropriate transportation choices are available to all, including people who do not own or drive an automobile.*

BACKGROUND TO THE PLAN

Bicycling and walking are increasingly recognized as a viable means of transportation in North America. Nonmotorized transport provides many benefits to users and non-users alike, including travel choice and mobility, affordability, reduced road congestion, infrastructure savings, improved health, recreation and enjoyment, environmental protection, and economic development. Walking and cycling improvements are critical for creating more livable communities.

According to ***name travel survey*** X.X% of trips in the City are currently made by walking, and X.X% are made by cycling. Market surveys indicate that the use of nonmotorized travel could increase significantly if given appropriate community support. Walking and cycling are key forms of transportation through neighborhoods, around schools, and in business districts. They are also popular forms of recreation. Walking in particular is expected to gain in importance as our population ages for recreation, exercise, and transportation.

Actions that support cycling and walking include:

- Language in the Official Community Plan supporting increased cycling and walking.
- Establishment of a Bicycle and Pedestrian Advisory Committee.
- Establishment of a bicycle and pedestrian coordinator position.
- Development of a trails or bikeway map.
- Directives in the Growth Strategies Act requiring consideration of bicycle and pedestrian infrastructure.
- Inclusion of bicycle specific training in new driver education materials.

BICYCLING AND WALKING GOALS

1. The City recognizes that approximately one-third of its residents do not drive and seeks to enable those residents to travel more safely throughout the City on foot, by bicycle, and by wheelchair. The City seeks to accommodate nonmotorized travel in order to provide equitable opportunity to all residents.
2. The City recognizes that nonmotorized travel can help develop a sense of community, encourage the patronage of local business, reduce noise and pollution, and improve the health of its residents. To realize these benefits, the City seeks to encourage nonmotorized travel, both functional and recreational.
3. The City recognizes that walking, jogging, hiking, and bicycling are popular forms of recreation and therefore it seeks to encourage and enhance those activities.
4. The City recognizes that walking and cycling are currently more dangerous than necessary, which causes unnecessary death and injuries, discourages nonmotorized travel, and imposes economic costs on the community. The City therefore seeks to make walking and cycling safer.

OBJECTIVES AND POLICIES

A Pedestrian and Bicycle Advisory Committee shall be established to oversee the development and implementation of a Pedestrian and Bicycle Network Plan. The Committee should include representatives of cyclists, pedestrians, parents, the physically challenged and appropriate government agencies. This Committee will:

1. Establish a planning process outline and schedule to indicate who is responsible for each task, when it should be accomplished, and opportunities for public involvement.
2. Develop a scoping document that outlines what issues are to be considered, summarizes available data on walking and cycling in the City, and identifies what would be required to obtain additional data that might be needed for planning purposes.
3. Survey users and potential users to identify existing problems and barriers to nonmotorized travel in the City, and opportunities for improving conditions. This should identify potential facility improvements and other activities, including education, law enforcement, and encouragement programs, that help achieve nonmotorized transport goals.
4. Develop preliminary estimates of the costs of implementing potential programs and projects.
5. Develop a framework for evaluating and prioritizing potential improvements.
6. Develop a recommended plan and overall budget. This could include a target for completion, for example, that all priority improvements be implemented within 10 years.
7. Seek pedestrian and cycling network program funding, including federal, provincial, and regional grants, and funding from local foundations, service clubs, and private individuals.
8. Establish design and maintenance standards for pedestrian and bicycle facilities, and review standards used by City departments that affect walking and cycling conditions.
9. Establish requirements for bicycle parking facilities as part of municipal parking codes, and educate city officials and builders concerning appropriate bicycle rack and locker design.
10. Recommend changes to other municipal policies to support nonmotorized transportation, including roadway design and maintenance standards, changes to zoning codes, municipal traffic bylaws and law enforcement practices, and other appropriate changes.
11. Work with Transit agencies to integrate bicycling into the local transit system, including bicycle racks on buses, bicycle lockers and racks at park and ride lots and bus terminals.
12. Recommend standards for new development to create more pedestrian and bicycle friendly communities, such as a modified grid street system with minimal cul de sacs, and the provision of trail connections between cul de sac or dead end streets where possible.
13. Develop recommendations for any actions needed to coordinate pedestrian and bicycle planning with other jurisdictions, including regional and provincial agencies.
14. Develop bicycle education program in coordination with community partners which may include bicycle clubs, police agencies, service clubs, and other groups.
15. Prepare and distribute information about traffic laws, bicycle safety, bicycle theft, major collision types through bicycle and sport shops, and public information sites.
16. Support bicycle encouragement programs, such as Bicycle Commuter Week and bicycle tourism promotion efforts.
17. Establish policies for evaluation and updating pedestrian and bicycle plans in the future.

The Engineering Department Will:

1. Identify specific bicycle and pedestrian projects in its annual Capital and Current Budgets. The Bicycle and Pedestrian Advisory committee will have the opportunity to comment on these budgets before their consideration by City Council.
2. Implement pedestrian and bicycle facility design and maintenance standards, and modify roadway design and maintenance standards as needed to improve the cycling environment.
3. Collect information on walking and bicycle travel patterns in all future travel surveys.
4. Revise existing subdivision design standards and conditions to ensure that subdivisions are designed with direct pedestrian and bicycle connections and suitable transit access.
5. Organize bicycle and pedestrian planning workshops for Engineering staff, members of the Bicycle and Pedestrian Advisory committee, and other appropriate stakeholders.
6. Coordinate efforts with the Parks and Recreation Department to ensure that connections between on-street and off-street facilities are well designed.
7. Notify the Advisory Committee about all major road works and sewer projects where wide curb lanes, sidewalks, or pathways can be established.
8. Initiate a "Spot Improvement Program" to reduce hazards along popular cycling routes and major pedestrian routes through small-scale, low cost improvements. Bicycle hazards include dangerous potholes, sewer grates, and railway crossings. Pedestrian hazards include missing curb cuts, missing links, uneven and cracked sidewalks. Priority should be given to improvements along the routes identified on the Bicycle and Pedestrian Network Maps. It is recommended that funds from the existing road maintenance budget be used. A telephone "hotline" or postcard program should be established to provide cyclists and pedestrians with the convenient opportunity to suggest improvements.
9. Revise its design standards and specifications to ensure bicycle and pedestrian access across and beneath new and renovated bridges and overpasses.
10. Revise the standard tender specifications so that only bicycle-safe sewer grates are purchased.
11. Establish standards to ensure access and safety to pedestrians and cyclists during construction projects.
12. Ensure that all bicycle and pedestrian projects comply with recognized design standards, such as the *Guide for the Development of Bicycling Facilities* prepared by the America Association of State Highway and Transportation officials (AASHTO).

The Parks and Recreation Department Will:

1. Identify specific bicycle and pedestrian projects in its annual capital and current budgets. The Bicycle and Pedestrian Advisory Committee will have the opportunity to comment on these budgets before their consideration by City Council.
2. Develop path and trail maintenance and repair programs, which should include maintenance standards, a well publicized method for users to report problems, scheduled maintenance, and, if appropriate, use of volunteers to help perform maintenance tasks.
3. Ensure that trails and path accommodate an appropriate range of users. This recognizes that many cyclists prefer to ride on separated paths instead of roads and that the development of pathways will attract walkers, dog walkers, in-line skaters, joggers, and cyclists. It also means that users with special needs, including people with disabilities, children, and elderly will be accommodated on such facilities whenever possible.
4. Provide appropriate signage to identify paths and trails, encourage appropriate trail behaviour, and warn of hazards.
5. Monitor rail-related, utility, or natural area actions to ensure that opportunities to develop pathways within abandoned rail corridors are not missed.
6. Monitor conflicts on trails and paths and take appropriate actions to minimize conflicts.
7. Develop a city or regional bicycle map.
8. Identify priority locations for pathway improvements. This includes pathways that are too narrow, in poor repair, and poorly designed.
9. Prior to the City's selling or otherwise disposing of public rights of way, the City consider the use of those lands as part of the overall paths/trails system or as informal walkways for nearby residents.
10. When deciding whether to accept lands proffered, either for purchase or otherwise, the City consider the possible use of those lands for off-road travel on foot or by bicycle.

Law Enforcement Agencies Will:

1. Establish policies for the enforcement of bicycle traffic laws. This should include education for traffic officers concerning bicycle laws and cyclists rights, education and outreach programs to cyclists and motorists, prioritization of violations that will be cited, policies for citing and fining cyclists (including children and other cyclists who do not have a drivers license), and development of a "diversion" program, by which cyclists who violate traffic laws can take a bicycling safety class as an alternative to paying a fine.
2. Provide an advanced bicycle skills course to all staff using bicycles for policing, to ensure safe and appropriate riding skills for safest riding, and to provide model examples for other cyclists.
3. Compile and analyze reported bicycle and pedestrian collision statistics on an annual basis. This information will be reviewed by the Pedestrian and Bicycle Advisory Committee and Engineering Department staff to determine ways to reduce road hazards.

Public Involvement

Public involvement is essential to good pedestrian and bicycle planning. Public involvement can help educate stakeholders, gather information, identify public opinions and priorities, and develop new ideas and plans. The following techniques can make public involvement effective.

1. Visioning

It can be useful to begin a planning process with open-ended discussion of what might constitute optimal pedestrian and cycling conditions in a community's future. This sort of visioning can involve any interested citizens. It looks for common ground among participants and produces a broadly based statement on what the community should strive to achieve.

2. Brainstorming

Brainstorming involves freethinking for solutions to a particular problem or set of problems. Issues should be carefully defined prior to the brainstorming session. Generally, as many ideas as possible are listed without comment, then the ideas are evaluated, and finally prioritized. All participants are fully invited to give ideas and no one person is allowed to dominate. In this type of creative and non-critical environment, contentious issues can be viewed in a new light. Brainstorming requires a facilitator who must be sensitive to group dynamics and be able to draw statements and positions for participants.

3. Charrette

A charrette is a special meeting involving all stakeholders and resource people to develop a plan or resolve a particular problem. It is typically a day or multi-day event. The objective is to have a basic plan completed by the end of the meeting.

4. Public Meetings

A public meeting is held to present information and obtain feedback from citizens. It provides for a presentation from the agency with opportunities for questions and public comment. Anyone may attend a public meeting. They should be well publicized, particularly to appropriate interest groups. Public meetings should be held in locations that are accessible to all users, and people with special needs should be accommodated as much as possible.

5. Publicity

Publicity can be used to inform stakeholders about issues and events through newspapers, radio, TV and videos, billboards, posters, direct mail, or flyers. Media strategies should be incorporated into any project that needs public focus, consensus, and understanding for it to move forward.

6. Advisory Committee

Many communities establish temporary or permanent pedestrian and bicycle advisory committees with representation from various stakeholder groups as part of nonmotorized transportation planning. The role of an advisory committee is to review and comment on transportation policies and plans from a pedestrian and cyclist perspective and to recommend policies and actions. In addition to helping develop a plan, an advisory committee can help solve future problems, negotiate solutions to conflicts, and support specific projects, such as field surveys, and safety education programs.

Planning Tip

Recipe For Developing And Maintaining An Effective Committee.

Recruitment – Recruit members with a range of perspectives and abilities, and who can make a significant contribution to the work involved.

Orientation – Provide new appointees with a solid orientation which may include the committee's role including duties and responsibilities, how the committee is organized, how the committee works, a review of the committee's structure, policies and bylaws, and a review of the committee's relationship with citizens, staff, and the governing body.

Training – Organize field trips, send members to conferences, arrange presentations, and provide committee members with material relevant to bicycle and pedestrian planning, and group and advocacy processes.

Work Plan – Encourage your committee to determine its priority projects once a year to focus energies. Committee members may also be assigned responsibility for individual projects.

Organizing Meetings – Make sure that the important issues are brought to the committee. Schedule priority items early in the agenda and provide background material to help deal with difficult questions.

Committee Credibility – The committee members must understand their role as advisory member bodies providing vision, direction, and assistance to programs. Staff members can help committees by identifying decision-makers and how to expedite (or delay) initiatives.

Recognition – Committee members are volunteers and need appreciation for the contribution of their time and energy.

Appendix 2 Quick Facility Design Guidelines

Pedestrian Planning Guidelines

Topic	Required or Recommended	Reference
Access for People with Disabilities	In general, accessible design requires the elimination of obstacles within the route of travel, 0.9 m minimum width of travel route, 1.5 m passing areas every 60 m on accessible routes less that 1.5 m in width, maximum grade of 1:20, steeper grades of up to 1:12 may have ramps and 1.5 m level landing areas for every 0.8 m in elevations change along 1:12 ramps.	WSDOT 33-47
Crosswalks	A marked crosswalk includes the use of pavement markings and either signs or signals. Pavement markings should not be used alone to indicate a pedestrian crossing, and signs should be supplemented by pavement markings. Crosswalk signs should not be where pedestrian or full vehicle signals are in place (MoTh, 94, 1-3). Stop bars, or twin lines for pedestrian crossings, are suitable only where the approach is controlled by means of a signal or stop sign. Zebra markings are recommended where there are no signal controls as they are more visible to drivers. The length of the zebra stripe differs according to traffic speed (3.0 m where speed is 60 km/h or less, 4.0 where speed is 70 km/h and greater.	
Special Crosswalks	Special crosswalks include pavement markings, internally illuminated overhead signs, down lighting of crosswalk, push buttons, timers, and overhead flashing beacons. These devices can be used in combination to make a crosswalk safer and more effective. Where traffic speeds and volumes are very high, grade separated crossings provide the best protection and ease in crossing to pedestrians.	
Curbs and Edge markings	Curbs are useful to provide a physical separation between pedestrians and traffic. They stop vehicles from mounting the curb for parking, and the gutter acts as a path for storm water drainage. In rural areas, a curb may seem too urban, and a ditch or swales provide separation. An extruded (asphalt) curb is not recommended where there are bicycle lanes, and may interfere with drainage. Raised pavement markings are strongly discouraged as a hazard for cyclists.	
Drainage Grates	Drainage Grates are best if located outside the route of pedestrian travel, if not possible, the openings should be less than 13 mm in width and should be mounted flush with the surrounding sidewalk surface.	WSDOT 90
Hand Rails	In steep areas, continuous handrails are to be provided at a height of 865 to 920 mm to help people in danger of slipping and falling.	STEPS, 41
Grades	An accessible route of travel should not exceed a grade of 1:20 or 5 percent. If the grade must exceed this maximum, a ramp of not greater than 1:12 or 8.33 percent may be constructed. Landings of 1.5 metres in length are required for every 9.1 metres of vertical height and must have handrails and railings. There are exceptions where the distance is minimal, though a slope of greater than 12 percent is difficult for many users.	*Building Access Handbook:* 1998.
Sidewalks	The minimum acceptable width for sidewalks is 1.5 metres on local streets and 1.8 metres elsewhere, and wider where there are greater numbers of pedestrians. Where a walkway is less than 1.5 metres wide, passing areas must be installed. Vertical clearance must be a minimum of 2 metres, AASHTO recommends a minimum of 2.4 metres. A cross slope must not be greater than 2 percent but must allow for adequate drainage. Sidewalks must not tilt where driveways cross the street as this adds difficulty to walking for people who may be mobility impaired. There are acceptable designs requiring an extension of a level sidewalk into the driveway; dipping the entire sidewalk where crossed by a driveway may result in drainage problems and add complications to sidewalk travel.	WSDOT 37

Sidewalk Ramps (Curb Cuts)	Ramps are useful for all people, baby strollers, luggage wheels, in-line skaters, bicyclists, and people in wheelchairs. They provide accessibility at intersections, building entrances, and other areas where elevated walkways are edged with curbing. It is recommended that curb ramps have a detectable warning surface for people who are visually impaired. A warning surface is required at transit ramps. Ramps must be included on two sides of a corner to point pedestrians across to the other curb and must be 0.9 metres wide with a maximum grade of 1:12 and 1:10 on side aprons. Curb cuts for multi-use paths should be the full width of the pathway.	WSDOT39
Street Furniture	Street furniture signs, trash cans, and utility boxes may pose hazards to the visually impaired person. In general, it is suggested that street furniture be grouped together to be more noticeable than they would individually and take up less room. Add contrast with a brighter color, maintain a clear height of pedestrian walkways, and place grouped objects in an area with a different surface, and/or mark with a tactile strip.	Scott, 46
Street Trees	A minimum planting strip is about six feet in width from the edge of the curb to the edge of the sidewalk. This provides adequate space for the tree to develop, although as little as four feet may be adequate. Trees may be planted in 20, 30, 40 or 50-foot intervals and should form a canopy overhead. Trimming trees to about 9 feet in height preserves sight lines for drivers and pedestrians. Tree species should be carefully chosen for good performance.	
Tree Roots	Potential hazards from tree roots can be controlled by laying a good base of crushed gravel above the tree roots and below concrete sidewalks so they can grow without causing cracks in the sidewalk. (Scott 41). Tree roots that may be a hazard to pedestrians can be painted yellow as a warning.	STEPS 41
Surface	Smooth surfaces such as cement concrete or asphalt are firm and stable enough to support wheelchair wheels, crutch tips, and other mobility aids. Smoothed gravel screenings may be acceptable in recreational settings, however loose gravel and wood chips generally do not provide for an accessible surface.	

Bicycle Facility Design Guidelines

Topic	Required and Recommended	Reference
Bicycle Parking	Secure short term and long-term parking must be provided at all destinations. Class I, II and III parking can be required by bylaw; careful design and placement criteria are recommended for best results.	AASHTO 38 CIP C21
Bridges and over-passes	Special attention is needed to ensure adequate protection from traffic, adequate railing height and materials, and adequate width for sharing with pedestrians. A railing at handlebar height and one at shoulder height should be provided, do not use vertical railings or chain link fences that can easily snag a handle bar and cause a crash.	AASHTO 33 CIP 20.1.8-9
Construction zones	Bicycle lanes are to be rerouted for construction; adequate signage, and lighting must be in place. Where metal plates provide temporary road surfaces, they must meet the road at right angles and a ramp of asphalt provides a feathered edge for cyclists.	
Extruded Curbs	Extruded curbs should not be used to separate a bike lane from traffic as they present a hazard to the safe operation of the bicycle, make left hand turns impossible, and present cleaning difficulties	AASHTO 12
Drainage / Utility covers	Drainage and utility grates should be flush with the roadway surface and long openings should be placed at right angles to the wheel's travel. Ideally, grates and utility covers should not be placed in the bike lane, and curb inlets should be used instead.	AASHTO, 12 35
Intersections	Intersections (including driveways) are the most likely place for car-bike collisions. Intersections should be carefully designed to reduce the chance of conflict. Driveways should have adequate sight lines to see all traffic on the road. Bike lanes at intersections and bike paths where they connect with streets should be carefully designed. Intersections with freeways should be grade-separated.	AASHTO 18, 31
Lighting	Bicycle facilities should be adequately lit. Street lighting is usually sufficient for wide curb lanes and bike lanes; separated paths and bike parking areas require appropriate-scale lighting where evening walking and cycling is expected. Intersections of paths with roads must be well lit.	AASHTO 35
Maintenance	Regular maintenance is essential to ensure that the facilities are safe and comfortable to use. Road and path surfaces should be swept regularly to remove glass and other debris. They should be given the same or greater maintenance standard as motor vehicle travel ways due to the absence of the "sweeping action" from regular car travel.	AASHTO 41
On Road Facilities *Bike Lanes*	All roads should be thought of forming the bicycle network. On major urban roads, bike lanes can increase safety and reduce conflicts with other vehicles. Bike lanes should always be one-way facilities carrying traffic in the same direction as adjacent motor vehicle traffic. The minimum width for a bike lane should be 1.2 m excluding curb and gutter, 1.5m when next to a parking lane). Bike lanes should end well in advance of intersections, with dashed lines adjacent to right turn lanes to encourage traffic to merge into the bike lane before turning. Bike lanes should be located to the far right of the road, or between the parking lane and the travel lane.	AASHTO 18 - 20 FHWA 16-21 MUTCD 9C2-9C3 CIP20.2-3
Wide Curb Lanes	Curb lanes should be between 12 and 14 feet, or 3.7-4.3m. Wider curb lanes may encourage two motor vehicles to operate in one lane.	AASHTO 14, 15

Shoulder Width	Wide shoulders are preferred for accommodating cyclists in rural areas and should be a minimum of 1.2 m when intended to accommodate bicycle travel. Where shoulders are narrower, they should not be signed as bikeways. Wider width is desirable when speeds are higher than 55km/h, there is a large percentage of truck traffic or if obstructions exist.	AASHTO 14, 15
Bicycle Boulevards and Local Streets	Bicycle boulevards are streets that encourage cycling and discourage motor vehicle traffic by means of traffic calming devices. On local streets, bicycle route signs may be desired where they form part of the bicycle network.	
On–street parking	On-street parking can pose risks to cyclists who ride past, and people with disabilities as they exit their vehicles. Where cars are parallel parked, a bike lane may be provided between the road and parked cars if the bike lane is wide enough and far enough from the vehicles to avoid car doors opening into the bike lane. A bike lane should never be place to the right of parallel parking. Diagonal or perpendicular parking is very dangerous and bike facilities should be avoided in these areas. (WSDOT, 1995)	
Pavement Structure	A bike facility may be cement, asphalt, or fine gravel screenings. However, the surface should be at least as smooth as that provided for vehicles and tree roots should be prevented from disrupting the smooth surface.	AASHTO 13, 32
Railroad Crossings	Railroad crossings should be at right angles to the rails as acute angles may trap the wheels and cause crashes. The travel way should be widened if the crossing angle is less than 45 degrees to permit a wider crossing angle. Warning signs and pavement markings should be posted before the crossing. Road surfaces should be flush with the rails. Rubberized flanges around the rails or removal of unused track can minimize the danger for cyclists.	AASHTO 12 MUTCD 9C-4
Intermodal Linkages	Airports, rail, buses, and ferries permit cyclists to reach distant destinations. All trains should be designed to permit bicycles as checked baggage, or in the passenger car. Terminals should provide for secure bicycle parking, and areas may be provided for bicycle set up, and clear access to the station should be provided. Transit buses should be equipped with racks to carry at least two bicycles.	AASHTO 38
Ferries	Ferries sometimes represent a vital link in the transportation system. Provide for bicycle traffic on vehicle and passenger ferries and at ferry terminals by dedicating bicycle routes through the terminal to boarding areas and providing secure and protected parking at the terminal and on the ferry to prevent damage, theft, and weather exposure.	
Separated Facilities	Separated bicycle facilities should NOT be thought of as a substitute for accommodating bicycles on nearby roads. These paths should be considered extensions to the street system and meet an important recreational need. Two-way paths need careful attention to detail where they intersect with traffic. Twinned paths on each side of a road provide more safety, especially at intersections. The minimum width for a one-way path is 1.5 m, and a wider (4m+) path with markings down the center of the path may minimize conflicts where there is heavy traffic. Converting rail lines to trails provide good facilities with good sight lines and shallow grades. Good access including motor vehicle parking, water, toilets, and telephones make for a successful facility.	AASHTO 15 - 36
Sidewalks and Ramps	Cycling on the sidewalk is generally not recommended for safety reasons, as there is a high potential for collisions at driveways and intersections.	
Traffic Control Devices	As bicycles are legal vehicles on the road, they do not require special traffic control devices. The same standards which apply to street signs and highways also apply to bicycle facilities. High-traction, non-skid paint should be used on road surfaces.	AASHTO 13 paint 32 signals 13
Traffic Control Devices Bollards	Bollards should be placed where vehicles may enter a bike path; one should be placed in the center, with bollards to the side, each providing 1.5 m clearance. They should be painted white and have reflectors.	AASHTO 63

Traffic Signals	All traffic signals should be adjusted to detect bicycles. Quadrapole loop detectors are more sensitive to bicycles and may be more effective than standard loop detectors. The most sensitive area of the detector should be stenciled with a bicycle symbol. The right-most and left turning lane should be stenciled in this way. The clearance interval for intersections should be at a bicycle speed of 16km/h with 2.5 second braking time	AASHTO, 13
Traffic Signs	Standard signs are adequate for most bicycle facilities. Signs specifically directed at cyclists should be smaller and lower than normal street signs. Signs should be between 1.2 and 3.0 meters in height and should be 1.0 metres from the edge of the bicycle path to provide adequate clearance for cyclists who may veer off the path to pass. Consideration should be given to adequate stopping distance to heed the warning or information on the sign. BIKE ROUTE signs should be used in conjunction with sub-plates indicating destinations (with distances) to be found along the signed route. In addition, BIKE ROUTE signs must be part of a comprehensive system. At junctions of separated trails with roadways, the name of the road should be clearly visible to trail users.	AASHTO 32 MUTCD 2A-9, CIP,47
Traffic Calming Devices	Traffic calming measures usually benefit cyclists by removing or slowing traffic. Some measures need to be carefully designed to accommodate cyclists. For example, where speed bumps or diverters are used, a by-pass area for cyclists should be included. Where pinch-points are used, rolled curbs reduce the danger of being squeezed. Traffic calming devices can also be used as refuges for cyclists crossing two-way busy roads. Refuges should be 3 metres wide, by two metres across and provide handrails and bollards.	CIP 20.1.11
User Conflict	Design features and user policies should be used to minimize conflicts between cyclists, pedestrians and equestrians.	AASHTO 37
Vegetation	It is important that vegetation near roadways and paths be maintained. All vegetation above .3 meters in height should be trimmed back a least 1-m on each side of all paths. Vegetation at intersections should be trimmed to provide adequate sight lines. Tree and shrub roots may cause disruption in a path surface, removal of trees within 1 m of the path and the use of root barriers may help to reduce problems.	AASHTO 41
Workplace Facilities	Many people say that they would try commuting by bike but feel they need a shower and a place to change clothes once they arrive at work. Some jurisdictions are requiring that such facilities be provided when a building is built or remodeled. Clothes lockers, large enough to accommodate a week's worth of clothes and toilet articles, can be provided. A bathroom may be remodeled providing a shower stall.	

Appendix 3 Evaluating Nonmotorized Travel

It is important to develop ways to measure the quality of walking and cycling conditions to identify problems and prioritize improvements. This section describes such techniques.

Surveys

It is often useful to survey the public to identify the problems they perceive with current pedestrian and cycling conditions, and opportunities and priorities for improvements. Public survey forms can be distributed throughout a region, or be targeted at a particular area. Survey forms can be handed out along a sidewalk, path or roadway, can be attached to bicycles and automobiles parked at a study site, or can be distributed through local newsletters and employers. The Partnership for a Walkable America has an Internet-based survey form to evaluate walking conditions (www.nsc.org/walk/wkcheck.htm) that could be replicated in individual communities.

Special consideration should be given to pedestrian and bicycle planning along urban and suburban arterials, highways near urban areas, and highways that connect to parks, schools, residential neighborhoods, employment centres, and other trip generators.

Example

Nonmotorized Transport Survey Questions[55]

1. Are your neighbourhoods designed to promote walking and cycling to get to school, work, recreation, transit, and retail outlets? Are these facilities used?
2. If these facilities are not used, what improvements could make them more accessible?
3. Is street lighting adequate?
4. Are sidewalks maintained, repaired, and cleared of snow in the winter?
5. Are bike lanes part of the roads?
6. Does your community master plan include facilities for cycling and walking?
7. Are there cycling organizations in your community promoting the use of bicycles?
8. Are there bicycle racks at transit stations and outside municipal facilities?
9. Do school organizations promote walking, cycling, and safety programs for both?
10. Do schools and workplaces provide secure bicycle parking?
11. Are local government officials aware of the walking and cycling needs of neighbourhoods?
12. What measures could be taken to calm traffic in your residential neighbourhoods?
13. Can community groups be encouraged to organize bicycle safety workshops?
14. Do local businesses support walking and cycling to their stores?
15. What groups might be involved in promoting active transportation in your community?
16. Are residents encouraged to keep sidewalks clean and clear of snow?
17. Is there bicycle parking near shopping areas and other destinations?

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[55] *Developing Communities for Active Transportation*, Go For Green (www.goforgreen.ca), 1998.

Crash Data

Pedestrian and bicycle collision data can help identify barriers and hazards to nonmotorized travel. Locations with frequent pedestrian or cycling crashes indicate some combination of high risk or heavy use, both of which can justify facility improvements. Crash analysis can be used to identify a variety of possible safety interventions, including pedestrian and bicycle facility improvements, traffic management and traffic calming to reduce vehicle speeds and volumes, and increased traffic safety education and law enforcement for drivers, pedestrians, and cyclists. Pedestrian and cycling collisions tend to be underreported, so a variety of data collection methods may be needed.[56]

Crash data should be evaluated by type of crash and contributing factors, pedestrian and cyclist demographics, location type (for example, pedestrian crashes can be categorized by intersection crosswalk, midblock crosswalk, midblock no crosswalk, driveways, etc.) to identify possible patterns. Smaller communities may only have few pedestrian/cyclist crash reports to work with. Larger communities may find it valuable to establish an ongoing program to analyze pedestrian/cyclist crash data, and integrate it into a municipal mapping program.

Field Surveys

Some transportation agencies use volunteers or hired college students to perform field surveys of pedestrian and cycling conditions. If possible, surveys should include special user groups, such as people in wheelchairs and elderly pedestrians, particularly in areas they frequent. The box below lists typical information to collect.

Field Survey Data to Collect (as appropriate)

- Roadway vehicle traffic volumes and speeds.
- Intersection design, roadway and road shoulder widths, and pavement conditions.
- Nonmotorized traffic volumes and speeds, and available accident data.
- Special hazards to walking and cycling (potholes, dangerous drain grates on road shoulders and curb lanes, etc.).
- Crosswalk, sidewalk, and path conditions (width, surface condition, sight distance, etc.).
- Curb cuts, ramps and other universal access facilities.
- Lighting along streets and paths.
- Presence of parked cars adjacent to the traffic lane.
- Bicycle parking facilities, public washrooms, and other services along trails and bike routes.
- Security, cleanliness, vandalism, litter, and aesthetic conditions.
- Community demographics (age, income, etc.)
- Presence of activity centers that attract nonmotorized travel (schools, colleges, resorts, etc.)
- Land use factors, including density and mix, street connectivity, and building site design.
- Topography and climate.

[56] Helen James, "Under-reporting of Road Traffic Collisions," *Traffic Eng+Con*, Dec. 1991, pp. 574-583.

When evaluating facilities it is important to clearly maintain the distinction between *nominal* ("in name") and *functional* ("working condition") dimensions. For example, many sidewalks and paths are nominally 1.8 to 2 metres wide, but functionally they may be much narrower, due to objects such as telephone poles and signposts located in their right of way, and due to surface failures, such as cracks and potholes. As a result, a walkway that meets technical specifications may be inadequate for some potential users. Similarly, a bike lane may be useless if it has poor surface conditions or is frequently used for vehicle parking.

It may be difficult to obtain consistent evaluations of roadway conditions by different surveyors. Some cyclists are comfortable riding on roads with heavy, high-speed traffic, and are critical of paths that restrict cycling riding speed due to design limitations. Others have the opposite preferences. This problem can be minimized by establishing clear evaluation criteria. For example, rather than simply rating a highway condition as "good" or "bad" for cycling it may be better to record traffic volumes, shoulder width, shoulder condition, and "special problems for cyclists." Training and supervision can help guarantee consistency between survey teams.

Bicycle and Pedestrian Level-of-Service Ratings

Table A3-1 summarizes a simplified method for evaluating walking and cycling level-of-service. Scores: A = >17; B = >14-17; C = >11-14; D = >7-11; E = >3-7; F = 3 or less.

Table A3-1 **Bicycle and Pedestrian Level-of-Service for Congestion Management**[57]

	Bicycle	Points	Pedestrian	Points
Facility	Outside lane 3.66 m (12')	0	Not continuous or non-existent	0
(Max. value = 10)	Outside lane 3.66-4.27m (12-14')	5	Continuous on one side	4
	Outside lane >4.27m (14')	6	Continuous on both sides	6
	Off-street/parallel alternative		Min. 1.53 m (5') wide & barrier free	2
	facility	4	Sidewalk width >1.53 (5')	1
			Off-street/parallel alternative facility	1
Conflicts	Driveways & sidestreets	1	Driveways & sidestreets	1
(Max. value = 10)	Barrier free	0.5	Ped. Signal delay 40 sec. or less	0.5
	No on-street parking	1	Reduced turn conflict implementation	0.5
	Medians present	0.5	Crossing width 18.3 m (60') or less	0.5
	Unrestricted sight distance	0.5	Posted speed	0.5
	Intersection Implementation	0.5	Medians present	1
Speed Differential	>48 KPH (>30 MPH)	0		
(Max. value = 4)	40-48 KPH (25-30 MPH)	1		
	24-30 KPH (15-20 MPH)	2		
Amenites			Buffer not less than 1m (3'5")	1
(Max. value = 2)			Benches or pedestrian scale lighting	0.5
			Shade trees	0.5
Motor Vehicle	LOS = E, F, or 6+ travel lanes	0	LOS = E, F, or 6+ travel lanes	0
LOS	LOS = D, & < 6 travel lanes	1	LOS = D, & < 6 travel lanes	1
(Max. value = 2)	LOS = A,B,C, & < 6 travel lanes	2	LOS = A,B,C, & < 6 travel lanes	2
Maintenance	Major or frequent problems	-1	Major or frequent problems	-1
(Max. value = 2)	Minor or infrequent problems	0	Minor or infrequent problems	0
	No problems	2	No problems	2
TDM/Multi Modal	No support	0	No support	0
(Max. value = 1)	Support exists	1	Support exists	1

[57] Linda Dixon, "Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems," *Transportation Research Record 1538*, 1996, pp. 1-9.

The Barrier Effect

Roads are usually considered transportation links, but they can also be barriers, especially to nonmotorized travel.[58] The "barrier effect" reduces walking and cycling mobility, and increases driving.[59] This is not to imply that drivers intentionally cause harm, but rather that such impacts are unavoidable when fast, heavy vehicles share space with more vulnerable road users.

Cycling Condition Evaluation Techniques

Table A3-2 shows one method for evaluating cyclist stress levels, taking into account traffic speed, volume, type, operating space, and number of hindrances (intersections and commercial driveways) on a specific stretch of roadway.[60]

Table A3-2 **Cyclist Stress Level Values**

Stress Rating	Speed	Volume	Trucks	Curb Lane	Hindrances
	Posted speed limit (km/hr)	Vehicles/hr per traffic lane	Percentage of truck traffic	Curb lane width (m)	Commercial driveways and intersections per km
1	<40	<50	<2%	>4.6	<6
2	50	51-150	4%	4.3	13
3	60	151-250	6%	4.0	19
4	65	251-350	8%	3.7	25
5	>75	351-450	>10%	<3.3	>31

These values are used to calculate Cycling Suitability Rating in Table A3-2.

Table A3-3 **Cycling Suitability Rating**

Summed Values	Average Stress Level	Road Suitability for Cycling
< 7	1	Road is reasonably safe for all types of cyclists.
7-12	2	Road accommodates casual and experienced cyclists, but needs improvement to accommodate child cyclist.
13-17	3	Road accommodates experienced cyclists, but needs improvement to accommodate casual and child cyclists.
18-22	4	Needs improvements to accommodate experienced cyclists, not recommended for casual and child cyclists.
>22	5	May be unsuitable for all cycling.

[58] J.M. Clark and B.J. Hutton, *The Appraisal of Community Severance*, U.K. DoT, Transport Research Laboratory (Crowthorne, UK), Report #135, 1991.

[59] Todd Litman, *Transportation Cost Analysis; Techniques, Estimates and Implications*, VTPI (www.vtpi.org), 2000; Dr. Peter Bein, *Monetization of Environmental Impacts of Roads*, and *Social Cost of Transverse Barrier Effects*, Planning Services Branch, B.C. Ministry of Transportation and Highways (Victoria; www.th.gov.bc.ca/bchighways), 1997, 1995.

[60] David L. Harkey, Donald W. Reinfurt, J. Richard Stewart, Matthew Knuiman and Alex Sorton, *The Bicycle Compatibility Index: A Level of Service Concept*, Federal Highway Administration, FHWA-RD-98-072 (www.hsrc.unc.edu/oldhsrc/research/pedbike/bci/bcitech.pdf), 1998.

A more detailed system called the *Bicycle Compatibility Index* incorporates these factors:[61]

- Presence of bicycle lane or paved shoulder.
- Bicycle lane or paved shoulder width.
- Curb lane width.
- Curb lane volume.
- Other lane volume.
- Average traffic speed.
- Presence of parking lane with more than 30% occupancy.
- Type of roadside development.
- Truck volumes.
- Parking turnover.
- Right turn lanes.

Pedestrian Condition Evaluation Techniques

Generally available demographic, land use, and transportation planning data can be used to estimate pedestrian travel demand.[62] Traffic engineers often use Level of Service (LOS) to evaluate roadway performance for motor vehicle traffic. Pedestrian LOS for street crossings has been defined based on pedestrian delay, as shown in Table A3-4.[63] Crosswalk walking speeds are estimated at 1.2 metres per second for most areas, and 1.0 m/s for crosswalks serving large numbers of older pedestrians.

Table A3-4 **Pedestrian Road Crossing Level of Service (LOS)**[64]

Level of Service	Signalized Intersection*	Unsignalized Intersection*	Likelihood of Pedestrian Noncompliance
A	<10	< 5	Low
B	10-20	5-10	
C	20-30	10-20	Moderate
D	30-40	20-30	
E	40-60	30-45	High
F	≥ 60	≥ 45	Very High

* Average Delay Per Pedestrian in Seconds

A more sophisticated model, called the Walking Security Index (WSI), takes into account a wide range of variables that affect pedestrian safety, comfort, and convenience at roadway intersections, as summarized in Table A3-5. The "Fathom" model uses a technique called visibility graph analysis, which looks at how visually accessible any point is within a building or

61 David L. Harkey, Donald W. Reinfurt, J. Richard Stewart, Matthew Knuiman and Alex Sorton, *The Bicycle Compatibility Index: A Level of Service Concept*, Federal Highway Administration, FHWA-RD-98-072 (www.hsrc.unc.edu/oldhsrc/research/pedbike/bci/bcitech.pdf), 1998; David L. Harkey, Donald W. Reinfurt, Matthew Knuiman, "Development of the Bicycle Compatibility Index," *Transportation Research Record 1636*, 1998, pp. 13-20.

62 Julie Mercer Matlick, *If We Build It, Will They Come?*, Washington State DOT (Olympia; www.wsdot.wa.gov), undated.

63 Colin Henson, "Level of Service for Pedestrians," *ITE Journal*, Sept. 2000, pp. 26-30.

64 Joseph Milazzo, et al., Quality of Service for Interrupted Pedestrian Facilities in the 2000 Highway Capacity Manual, Transportation Research Board Annual Meeting, 1999.

area.[65] This is found to correlate well with observed flows because pedestrians are sensitive to lines of sight and visual access.

Table A3-5 **Walking Security Index Variables**[66]

Infrastructure	Vehicle Traffic	Pedestrian	Performance	Behavior
1. No. of lanes. 2. Speed 3. Grade (incline). 4. Turning lanes. 5. Curb cut at intersections. 6. Stop bar distance from crosswalk. 7. Sight lines	8. Peak vehicle volumes. 9. Vehicle types. 10. Trip purpose. 11. Turning movements.	12. Pedestrian volumes. 13. Pedestrian age.	14. Right-turn-on-red. 15. Signage. 16. Ice/snow/slush removal.	17. Pedestrian-vehicle collisions. 18. Pedestrian-vehicle conflicts. 19. Vehicle moving violations.

The four criteria below are each rated on a scale from 1-3, the total of which represents the Pedestrian Environmental Factor (PEF).[67] The results were found to correlate well with the use of non-automobile travel in an urban area. Urban neighborhoods with a high PEF tend to have twice the walk/bicycle mode share as the overall average, as much as five times greater than areas with the lowest PEF.

- *Ease of street crossings.* This is based on street width, traffic volumes, and speeds.
- *Sidewalk continuity.* Sidewalks that do not connect create barriers to pedestrian travel. A pedestrian network is only as good as its weakest link, particularly for people with physical disabilities. Even problems that appear minor to able-bodied pedestrians may be a major barrier to people with significant mobility constraints.
- *Local street characteristics (grid vs. cul de sac).* A grid street system provides continuity, allowing more direct access to destinations.
- *Topography.* Steep slopes create barriers to pedestrians.

An article in *Parking Today* suggested Level of Service ratings for pedestrian access to parking, which may be considered appropriate for walking trips in general. Acceptable walking distances are affected by degree of weather protection, climate, line of site (whether pedestrians can see their destination), and "friction" (interruptions and constraints along the way, such as cross traffic). The table below summarizes the findings.

[65] www.intelligentspace.com

[66] Barry Wellar, *Walking Security Index; Final Report*, Geography Department, University of Ottawa (Ottawa; 613-562-5725; wellarb@uottawa.ca), 1998.

[67] PBQD, *The Pedestrian Environment*, 1000 Friends of Oregon (www.friends.org) 1993.

Level of Service By Walking Trip Distance (in Feet)[68]

Walking Environment	LOS A	LOS B	LOS C	LOS D
Climate Controlled	1,000	2,400	3,800	5,200
Outdoor/Covered	500	1,000	1,500	2,000
Outdoor/Uncovered	400	800	1,200	1,600
Through Surface Lot	350	700	1,050	1,400
Inside Parking Facility	300	600	900	1,200

Prioritizing Improvements and Selecting Preferred Options

There are four factors to consider when evaluating barriers and gaps in pedestrian and cycling networks, and when prioritizing improvements:

1. *Level of demand.* How many people would use a facility if it were improved. In general, this increases around higher density areas, such as business districts and higher-density residential areas, and around attractions, such as schools and parks.[69]
2. *Degree of barrier.* This can range from minor difficulties (such as requiring pedestrians to use a longer route than if a proposed improvement is made) to a total barrier to walking and bicycling. The degree of barrier also depends on who is traveling, and under what conditions. People with physical disabilities are more vulnerable to such barriers.
3. *Potential benefits.* This refers to the benefits that could result from increased walking and cycling on that corridor. For example, improvements that encourage nonmotorized travel to substitute for driving may provide more value to a community than improvements used primarily for recreational cycling and walking.
4. *Cost and ease of improvement.* This includes the incremental financial costs of the project, and any increase in future maintenance costs.

This information can be presented in a matrix, such as the one below. Note that the concept of "cost" is inverted into "affordability" so all criteria can be ranked from high (best) to low.

Table A3-6 **Project Evaluation Matrix Example**

	Demand	Barrier Reduction	Social Benefit	Affordability (low cost)
Proposal 1	High	High	Medium	High
Proposal 2	Medium	Low	High	Medium
Proposal 3	High	Medium	High	Low
Proposal 4	Low	High	Medium	Low

It may be desirable to develop a more quantitative evaluation process. For example, proposals can be ranked from zero (worst) to 5 (best) for each criterion. The criteria can also be given a weight. These are then multiplied to create total points for each project. Rankings can be done by a small group of technical experts, a technical/public committee, or through a public survey.

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[68] PT, "How Far Should Patrons Have to Walk After They Park?" *Parking Today* (www.parkingtoday.com), May 2000, pp. 34-36.

[69] Cambridge Systematics and Bicycle Federation of America, *Guidebook on Methods to Estimate Non-Motorized Travel*, FHWA, Publication No. FHWA-RD-98-166 (available at www.tfhrc.gov), July 1999.

Table A3-7 **Project Evaluation Matrix Example**

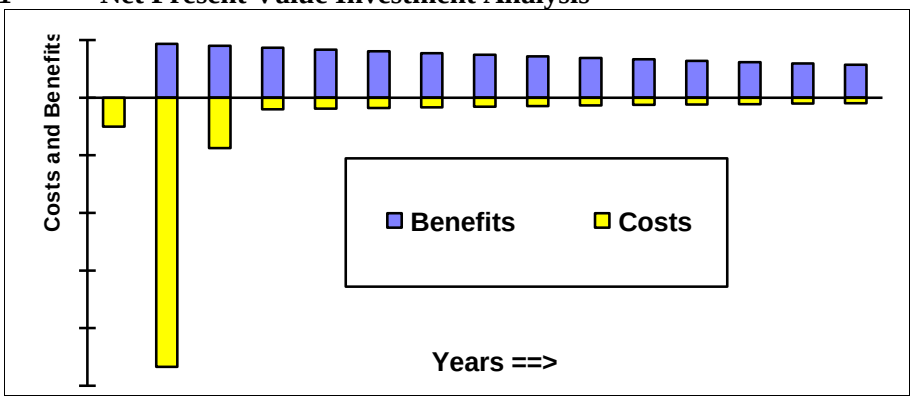
Weight	Demand 4	Barrier Reduction 3	Social Benefit 2	Affordability (low cost) 2	*Total Points*
Proposal 1	4	5	3	4	*45*
Proposal 2	3	2	5	3	*34*
Proposal 3	5	3	4	1	*39*
Proposal 4	2	4	3	1	*28*

Each criteria value is multiplied times the criteria weight factor.

Another approach is to develop a cost value that incorporates various criteria. For example, it may be possible to calculate *dollars per additional bicycle commuter*, or *dollars per pedestrian/cyclist-kilometre* using a new facility. This can be calculated by dividing the annualized project cost by the number of projected users.

A more sophisticated investment analysis technique uses net present values. This involves estimating all future costs and benefits, depreciating these based on a discount rate, and using a spreadsheet to calculate their net present value. The figure below demonstrates this with the example of a new pathway that has $1,300,000 in construction costs during the first three years, $20,000 annual maintenance costs, 200,000 annual trips the first year that increases by 3% annually, with an estimated benefit of $1.00 per trip. Note that the values decline over time due the discount rate. In this particular example, the net present value of costs is $1.4 million, while the net present value of benefits is $2.4 million.

Figure 1 **Net Present Value Investment Analysis**



However, such "condensed" values may exclude important factors. For example, two projects may have the same cost per additional bicycle commuter, but one provides far more recreational bicycling. Or, perhaps one provides more environmental, aesthetic, or equity benefits. Such differences should be described in evaluation reports.

The city of Portland uses two factors to prioritize pedestrian improvements. The "Pedestrian Potential Index" measure the potential demand for pedestrian travel, based on the areas PEF (described above), proximity to activity centers (such as schools, housing [especially senior housing] parks, transit, neighborhood shops), and policy factors, such as whether improvements to the pedestrian environment on that street are part of the regional strategic plan. The

"Deficiency Index" measures how critically pedestrian improvements are needed. The highest priority for pedestrian improvements are projects which rank high on both the Potential and Deficiency indices.[70] The same method could be used to prioritize cycling projects.

70 *Pedestrian Master Plan*, Pedestrian Transportation Program, City of Portland (503-823-7004; pedprogram@syseng.ci.portland.or.us), 1998.

Resources

Evaluating Nonmotorized Transportation Conditions

AASHTO, *Guide for the Development of Bicycle Facilities, 3rd Edition*, AASHTO (www.aashto.org), 1999; available at www.bikefed.org.

Cambridge Systematics and Bicycle Federation of America, *Guidebook on Methods to Estimate Non-Motorized Travel*, FHWA, Pub. No. FHWA-RD-98-166 (available at www.tfhrc.gov), 1999.

David E. Clark, *Estimating Future Bicycle and Pedestrian Trips from a Travel Demand Forecasting Model*, Compendium of Technical Papers, ITE (www.ite.org), 1997, pp. 407-414.

Linda Dixon, "Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems," *Transportation Research Record 1538*, 1996, pp. 1-9.

Ronald Eash, "Destination and Mode Choice Models for Nonmotorized Travel," *Transportation Research Record 1674*, 1999, pp. 1-8.

David L. Harkey, et al, *The Bicycle Compatibility Index: A Level of Service Concept*, FHWA, FHWA-RD-98-072 (www.hsrc.unc.edu/oldhsrc/research/pedbike/bci/bcitech.pdf), 1998.

Yael M. Levitte, *Bicycle Demand Analysis – A Toronto Case Study*, Transportation Research Board Annual Meeting (www4.nationalacademies.org/trb), 1999.

William Moritz, *Bicycle Facilities and Use*, Washington State Department of Transportation, (Olympia; *www.wsdot.wa.gov/ppsc/research/onepages/WA-RD3701.HTM*), 1995.

PBQD, *The Pedestrian Environment*, 1000 Friends of Oregon (www.friends.org) 1993.

PBQD, *Data Collection and Modeling Requirements for Assessing Transportation Impacts of Micro-Scale Design*, TMIP, USDOT (www.bts.gov/tmip), 2000.

Christopher Porter, John Suhrbier and William Schwartz, "Forecasting Bicycle and Pedestrian Travel," *Transportation Research Record 1674*, 1999, pp. 94-101.

Project for Public Spaces, *Effects of Environmental Design on the Amount and Type of Bicycling and Walking*, National Bicycling and Walking Study No. 20, FHWA, (www.bikefed.org), 1993.

PWA, *How Walkable is Your Community?* Partnership for a Walkable America (www.nsc.org/walk/wkcheck.htm), 2000.

W.L. Schwartz, et al, *Guidebook on Methods to Estimate NonMotorized Travel: Overview of Methods.* Turner-Fairbank Highway Research Center (www.tfhrc.org), FHWA-RD-98-165, 1999.

Alex Sorton and Thomas Walsh, "Bicycle Stress Level as a Tool to Evaluate Urban and Suburban Bicycle Computability," *Transportation Research Record 1438*, TRB, (www4.nationalacademies.org/trb/homepage.nsf), 1995, pp. 17-24.

University of North Carolina, *A Compendium of Available Bicycle and Pedestrian Trip Generation Data in the United States*, FHWA, (available through www.bikefed.org), 1994.

University of North Carolina Highway Safety Research Center (www.hsrc.unc.edu).

Portland Office of Transportation, *Portland Pedestrian Design Guide* and *Pedestrian Master Plan*, City of Portland (www.trans.ci.portland.or.us/Sidewalks_and_Pedestrians.html), 1998.

Barry Wellar, *Walking Security Index; Final Report*, Geography Department, University of Ottawa (Ottawa; 613-562-5725; wellarb@uottawa.ca), 1998.

Appendix 4 Exemplary Bicycle and Pedestrian Plans

Bicycle Plans

City of Santa Barbara
A comprehensive plan for integrating bicycling infrastructure into the city's street network, including on- and off-road facilities, and ancillary facilities such as bicycle parking, signing and other amenities. www.ci.santa-barbara.ca.us/pworks/transp/bike_plan/bmp_toc.html.

City of Portland, Ore.
During the 1990's the City of Portland has developed an extensive bicycling infrastructure including on- and off-street routes, bicycle parking, and other facilities. A Master Plan is at: www.trans.ci.portland.or.us/traffic_management/bicycle_program/BikeMasterPlan/Default.htm.
Contact: City of Portland, 1120 SW Fifth Ave, Room 730, Portland, OR 97204. (503) 823-7671.

City of Philadelphia, Pa
The City was awarded more than $3 million of Congestion Mitigation and Air Quality program funds to plan and implement a city-wide bicycle network featuring bike lanes, trails, and bicycle parking facilities. www.phila.gov/departments/street/html/the_bicycle_network.html.
Contact: City of Philadelphia Streets Department, (215) 686-5514,

City of Chicago, Ill.
Mayor Daley announced in the early 1990's that Chicago would become a bicycle-friendly city by the year 2000. A simple seven-page plan launched a series of improvements to existing facilities and the striping of several miles of bike lane each year. The plan has spawned more detailed bicycle plans: www.cityofchicago.org/Transportation/Bikes/bicycle.htm.
Contact: Bicycle Program, 30 N. LaSalle Street, #400, Chicago, IL 60602. 312-744-8093

City of Tucson, Ariz.
With a network of more than 240 miles of bikeway already on the ground, the Tucson Bikeway Improvement Plan identifies more than 50 additional miles of striped bike lanes that will be added to the system by 2001. www.ci.tucson.az.us/transport/planning/overview.html.
Contact: City of Tucson, 201 North Stone - 6th Floor, Tucson, AZ 85726. (520) 791-4372

New York City, NY
This award-winning plan identifies more than 900 miles of on- and off-street facilities and recommends a series of policies and programs that would promote bicycle use, encourage integration with transit, and link to the City's greenway system.
www.ci.nyc.ny.us/html/dcp/html/bndprods.html#b

Wisconsin Department of Transportation
Adopted in December, 1998, the Wisconsin Bicycle Transportation Plan 2020 provides a blueprint for more and safer bicycle trips with recommendations and roles for a variety of government agencies and groups. www.dot.state.wi.us/dtim/bop/finalbike.html.
Contact: Tom Huber, Wisconsin DOT, P.O.Box 7913, Madison, WI 53707. 608-267-7757

Pennsylvania Department of Transportation
One of the first ISTEA-generated statewide bicycle plans. The PennDOT plan included extensive public outreach and an intensive "in-reach" program for PennDOT staff and agencies. The plan incorporates an extensive design manual. Contact: PennDOT, 717-783-8444

Pedestrian plans

City of West Palm Beach, Fla.
The Transportation Element of the city's 1998 Comprehensive Plan establishes a new traffic hierarchy in which traffic calming is a key strategy in promoting walking and pedestrian safety.
Contact: Tim Stillings, Planning Department, P.O. Box 3366, West Palm Beach, FL 33402. (561) 659-8031.

City of Portland, Ore.
The City has adopted a two-part plan: Part One outlines the policies and plans for improving conditions for walking and Part Two is a detailed design manual for pedestrian facilities. www.trans.ci.portland.or.us/Sidewalks_and_Pedestrians.html.
Contact: Pedestrian Coordinator, City of Portland, 1120 SW Fifth Ave, Portland, OR 97204.

City of Madison, Wis.
Adopted in September 1997, Madison's visionary plan for walking incorporates planning, design, maintenance, and long-term goals and objectives. Madison was one of the first communities to adopt a separate plan for walking. www.ci.madison.wi.us/reports/execsum2.pdf.
Contact: Arthur Ross, City of Madison, P.O. Box 2986, Madison, WI 53701. 608-266-6225.

City of Tucson, Ariz.
Closely matching the City's bicycling plan, Tucson has adopted an ambitious plan to improve conditions for walking that is clearly identifiable in the City's annual workplan.
Contact: Tom Fisher, City of Tucson, 201 North Stone, Tucson, AZ 85726. 520-791-4372

Arlington County, Va.
Arlington County is one of the nation's densest urban areas and has developed a pedestrian plan that builds on the accessibility of two major transit corridors in the County. An extensive sidewalk building program is complemented by a neighborhood traffic calming program, all directed by citizen task forces. www.co.arlington.va.us/dpw/planning/ped/ped.htm.
Contact: Arlington County DPW, 2100 Clarendon Blvd - Suite 717, Arlington, VA 22201

North Central Texas Council of Governments
Bicycle and Pedestrian Facilities Planning and Design Guidelines, developed in December 1995 provides guidance on planning and designing facilities which improve bicycle and pedestrian mobility. www.nctcog.dst.tx.us/envir/bikeped/plandesign/execsumm.html.
Contact: Mike Sims, NCTCOG, P.O. 5888, Arlington, TX 76005. 817-695-9226

Washington State Department of Transportation
Washington State DOT adopted a Pedestrian Policy Plan in 1993 that focused on local and regional planning for pedestrians, necessary pedestrian facility types and locations, and who should pay for them. www.wsdot.wa.gov/hlrd/sub-defaults/pedestrian-default.htm
Contact: Julie Mercer Matlick, WSDOT, P.O. Box 47393, Olympia, WA 98504. (360) 705-7505

Oregon Department of Transportation
A comprehensive pedestrian (and bicycle) planning and design document. www.odot.state.or.us/techserv/bikewalk.
Contact: Michael Ronkin, Bicycle and Pedestrian Program Manager, ODOT, Room 210-Transportation Building, Salem, OR 97310. (503) 986-3555.

Appendix 5 Bicycle and Pedestrian Planning Resources

Roadway Design Resources

A Policy on Geometric Design of Highways and Streets, 1994 (The Green Book). American Association of State Highway and Transportation Officials (AASHTO), P.O. Box 96716, Washington, DC, 20090-6716, Phone: (888) 227-4860.

Stephen Burrington & Veronika Thiebach, *Take Back Your Streets; How to Protect Communities from Asphalt and Traffic*, Conservation Law Foundation (Boston; www.clf.org), 1995.

Wolfgang Homburger, et al., *Residential Street Design and Traffic Control*, Institute of Transportation Engineers (Washington DC; www.ite.org), 1989.

Highway Capacity Manual, Special Report 209, 1994. Transportation Research Board, Box 289, Washington, DC 20055, Phone: (202) 334-3214. Next Edition: FHWA Research Program project has identified changes to HCM related to bicycle and pedestrian design.

LMN Architects, *Model Code Provisions; Urban Streets and Subdivisions*, Washington State Community, Trade and Economic Development (www.wsdot.wa.gov/hldr/pdf/cted.pdf).

Manual on Uniform Traffic Control Devices, 1988. Federal Highway Administration (FHWA), Superintendent of Documents. P.O. Box 371954, Pittsburgh, PA 15250-7954. Includes standards for signing and marking both on-road and off-road bicycle facilities. Year 2000 edition will incorporate more bicycle and pedestrian standards.

Flexibility in Highway Design, 1997. FHWA. HEPH 10, 400 Seventh Street SW, Washington, DC 20590.

SWOV, *Best Practice to Promote Cycling and Walking*, Denmark Ministry of Transport (vd@vd.dk), European Commission Directorate General of Transport, 1998.

Pedestrian and Bicycle Planning

Best Practice to Promote Cycling and Walking and *How to Substitute Short Car Trips by Cycling and Walking*, CORDIS Transport RTD Program, European Union (www.cordis.lu/transport/src/adonisrep.htm), 1999.

BTS, *Bicycle and Pedestrian Data: Sources, Needs & Gaps*, USDOT (www.bts.gov/programs/transtu/bikeped/report.pdf), 2000.

Cambridge Systematics and Bicycle Federation of America, *Guidebook on Methods to Estimate Non-Motorized Travel*, Federal Highway Administration, Publication No. FHWA-RD-98-166 (available at www.tfhrc.gov), July 1999.

HSRC (Highway Safety Research Center, University of North Carolina), *Pedestrian and Bicycle Crash Analysis Tool* (PBCAT), Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA), available free from the Pedestrian and Bicycle Information Center (www.walkinginfo.org), 2000. This is a crash typing software product intended to assist development of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists.

Improving Conditions for Bicyclists and Pedestrians, A Best Practices Report, 1998. FHWA, HEP 10, 400 Seventh Street SW, Washington, DC 20590.

Making Streets That Work; Neighborhood Planning Tool, Engineering Dept., City of Seattle (www.ci.seattle.wa.us/npo/tblis.htm), 1996.

National Bicycle and Walking Study (24 volumes), FHWA, (Washington DC; www.bikefed.org), 1991-95.

National Highway Traffic Safety Administration's "Pedestrian and Bicycle Safety and Accommodation" course, (NHI Course NO. 38061, (www.ota.fhwa.dot.gov/walk). The course workbook is Publication No. FHWA-HI-96-028.

NYBC, *Improving Bicycling and Pedestrian Safety*, New York Bicycling Coalition (www.nybc.net/programs/NYBC_manual.shtml), 2002.

Pedestrian/Bicyclist Resource Kit, FHWA (www.ota.fhwa.dot.gov/walk).

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Useful Organizations

America WALKs (www.webwalking.com/amwalks) is a coalition of walking advocacy groups.

American Planning Association (www.planning.org) is a professional society for planners that sponsors a "Growing Smart" initiative and provides many extensive resources.

American Trails (www.outdoorlink.com/amtrails) fosters communication among trail users.

Association for Commuter Transportation (Washington DC; 202-393-3497; http://tmi.cob.fsu.edu/act/act.htm) is a non-profit organization supporting TDM programs.

Bicycle Information Center (877-925-5245; www.bicyclinginfo.org) is a comprehensive clearinghouse of bicycle planning and safety information supported by the U.S. Federal Highway Administration.

Bicycle Federation of America (Washington DC; 202.463.6625; www.bikefed.org) provides extensive resources for bicycle and pedestrian planning.

Canadian Cycling Association (Gloucester, Ontario; www.canadian-cycling.com) manages the Can-Bike cycling education program.

Carfree.com (www.carfree.com) explores carfree cities past, present, and future, and provides practical solutions to the problems of urban automobile use.

Center for Livable Communities (www.lgc.org/clc) helps local governments and community leaders be proactive in their land use and transportation planning.

Children on the Move site on children and transport: www.ecoplan.org/children.

The **Community Bicycle Network** (CBN) Factsheets, newsletter, curriculum guides, and action manuals, Detour Publications (www.web.net/~detour/cbn).

Community Transportation Association of America (www.ctaa.org) provides resources for improving mobility for disadvantaged populations.

Commuter Choice Program (www.epa.gov/oms/traq) provides information, materials and incentives for developing employee commute trip reduction programs.

Congress for New Urbanism (www.cnu.org) supports human scale urban communities.

David Engwicht Communications (www.lesstraffic.com.) supports "street reclaiming."

The U.S. **Federal Highway Administration's Pedestrian Program** (www.ota.fhwa.dot.gov/walk) provides pedestrian safety information and resources.

Green Lane Program, Environment Canada (www.ec.gc.ca/emission/5-1e.html) promotes TDM and other strategies for reducing transportation environmental impacts.

Go For Green, The Active Living & Environment Program (www.goforgree.ca) provides resources to promote nonmotorized transportation.

ICBC Road Sense (www.icbc.com) provides a variety of pedestrian and bicycle safety information including Safe Cycle Program material.

The **International Council for Local Environmental Initiatives** (www.iclei.org) provides planning resources to help communities become healthier and more environmentally responsible.

The **Institute of Transportation Engineers** (Washington DC; www.ite.org) has extensive technical resources on pedestrian and bicycle planning, traffic calming and TDM.

League of American Bicyclists (www.bikeleague.org/ec2/education.htm) provides a variety of bicycle education and encouragement resources.

The **Local Government Commission** (www.lgc.org/clc/pubinfo) provides a variety of useful resources, including pedestrian and bicycle planning publications.

National Highway Traffic Safety Administration (www.nhtsa.dot.gov) provides pedestrian and bicycle safety resources.

National Transportation Week Pedestrian Website (www.ota.fhwa.dot.gov/ntw/bikeped.htm) provides information and links to pedestrian planning websites.

Northwestern University Traffic Institute (Evanston, Illinois; 800-323-4011; www.nwu.edu/traffic) offers professional development workshops on bicycle planning and facility design, and other related subjects.

Oregon Bicycle and Pedestrian Planning (www.odot.state.or.us/techserv/bikewalk) is an example of nonmotorized planning at its best.

Perils for Pedestrians (www.pedestrian.org) is a cable television series promoting awareness of pedestrian safety. Their website includes advocacy tips and links to other walking organizations.

Partnership for a Walkable America (http://nsc.org/walk/wkabout.htm) promotes the benefits of walking and supports efforts to make communities more pedestrian friendly.

The **Pedestrian Association** (http://web.ukonline.co.uk/walkhf) has been campaigning since 1929 to make walking safer, more convenient, and easier.

The **Pedestrian and Bicycle Information Center** (1-877-WALKBIKE; www.bicyclinginfo.org) provides a variety of technical information on nonmotorized transport planning and programs.

Pedestrian Information Center (877-925-5245; www.walkinginfo.org) is a pedestrian planning and safety information clearinghouse supported by the Federal Highway Administration.

Pednet (www.ottawalk.org/pednet) is an Internet list with information on pedestrian issues.

Pednet's **International Pedestrian Lexicon** (glossary) http://user.itl.net/~wordcraf/lexicon.html

The **City of Portland** (www.trans.ci.portland.or.us/Traffic_Management/trafficcalming) provides excellent information and materials on traffic calming and pedestrian planning.

Project for Public Spaces (www.pps.org) is a non-profit organization that offers resources and technical support to help create special places that build community life.

The **Rails-To-Trails Conservancy** (www.railtrails.org) resources for public trail development.

The **Smart Growth Network** (www.smartgrowth.org) includes planners, govt. officials, lenders, community developers, architects, environmentalists and activists.

Sustainable Communities Network (www.sustainable.org) provides tools for community sustainability planning.

Transportation Association of Canada (Ottawa; www.tac-atc.ca) provides a variety of resources related to transportation planning and TDM.

Transportation for Livable Communities (www.tlcnetwork.org) is a resource centre for people working to create more livable communities by improving transportation.

Turner-Fairbank Highway Research Center (www.tfhrc.gov), provides extensive pedestrian and bicycle planning resources.

UK Department of the Environment, Transport and the Regions (www.roads.detr.gov.uk/roadsafety/rs/index.htm) publishes *Road Safety Education in Schools - Good Practice Guidelines* that describe how to create a safer pedestrian environment.

UK Health Education Authority (www.hea.org.uk) has excellent material to promote "transport exercise" and better integration of nonmotorized transport in public health programs.

Victoria Transport Policy Institute (www.vtpi.org) provides resources for planning and evaluating TDM, bicycling and walking programs.

Walkable Communities, Inc. (www.walkable.org) works with communities to create more people-oriented environments.

Washington Department of Transportation, TDM Resource Center (Seattle; 206-464-6145; www.wsdot.wa.gov) and **Northwest Technology Transfer Center** (Olympia; www.wsdot.wa.gov/TA/T2/publications.html) offer a variety of resources for TDM planning.

Way To Go! School Program (Vancouver; 1-877-325-3636; www.waytogo.icbc.bc.ca) provides resources and support for school traffic reduction programs.

World Health Organization Healthy Cities Project (www.who.dk/london99) provides information on international efforts to create healthy cities.

The **WSDOT Bicycle and Pedestrian Websites** (www.wsdot.wa.gov) provide extensive reference information for nonmotorized transport planning.

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