# An Exploration of Bicycle Use in the U.S.:

# National Findings and Local Implications

**Report 95.2**


**Washington State Transportation Commission**
**Innovations Unit**

Stephanie MacLachlan
Research Analyst

Shauna Badgett
Research Assistant

G. Scott Rutherford
Director

John M. Ishimaru
Senior Staff Member

University of Washington, JD-10
University District Building
1107 NE 45th Street, Suite 535
Seattle, Washington 98105-4631



Prepared for

**Washington State Transportation Commission**
Olympia, Washington

June 1995

| | |
|---|---|
| **Graphic Design** | Mary Marrah |
| **Report Design** | Amy O'Brien |
| **Production Coordinator** | Mary Catherine Snyder |
| **Technical Graphics** | Duane Wright |
| **Printing** | Washington State Transportation Center (TRAC)<br>University of Washington, Seattle |

**Printed on Recycled Paper**

**Production Run 1 (20)**

# Table of Contents

# List of Figures

# List of Tables

# Executive Summary

Traffic congestion, environmental degradation, and limited urban mobility are among the transportation-related problems that adversely affect the nation's economic health as well as Americans' quality of life. Cognizant that no single transportation mode or improvement can solve all these problems, the federal government has expressed commitment to non-motorized transportation. Evidence of this commitment includes the US Department of Transportation (USDOT) goal to double the percentage of bicycling and walking trips while simultaneously reducing by ten percent the number of accidents caused by bicycle and automobile collisions. Another indication of the federal government's commitment to non-motorized modes is the Intermodal Surface Transportation Efficiency Act's (ISTEA) passage in 1991. ISTEA changed fundamentally how local, regional and state governments finance various transportation programs. This new thinking "levels the playing field" between historically neglected alternative transportation modes and traditional highway programs.

As part of the effort to meet these USDOT goals and ISTEA regulations, Congress directed the USDOT to produce the *National Bicycling and Walking Study*, which was released in 1994. The 24 *Case Studies* assess the potential for non-motorized transportation, possible measures to meet the national goals, and how to overcome barriers to bicycling and walking.

Drawing upon the wealth of information presented in these *Case Studies*, this report begins to connect the barriers to encouraging utilitarian bicycling with the funding opportunities afforded by ISTEA. This relationship is important because once transportation policy-makers understand the reasons why people do not bike, they can develop policy and design counter-measures and identify the requisite ISTEA funding.

Chapter One presents findings of the barriers to bicycling as outlined by three *Case Studies*. Safety hazards are discussed in detail because unlike other barriers to bicycling such as weather and land use patterns, safety can be improved through short-term facility design modifications. Chapter Two presents new data regarding bicycle safety concerns from Puget Sound area employees and recommends facility design improvements. Chapter Three supplements the National Bicycling and Walking Study by describing the parts of ISTEA which most pertain to bicycles. Finally, new primary data are presented as to how metropolitan planning organizations (MPOs) are allocating some of their ISTEA funds for bicycle projects.

## DETERRENTS TO UTILITARIAN BICYCLING

Nationally, the number of people who use their bicycles for utilitarian purposes is under one percent. (Utilitarian purposes are defined as work or school commutes, shopping, or personal business.) Why is utilitarian cycling so rare, when polls show that Americans have a hearty interest in recreational cycling? According to the USDOT *Case Study no. 1 Reasons Why Bicycling and Walking Are and Are Not Being Used More Extensively as Travel Modes*, barriers to utilitarian bicycling can be separated into three tiers: (1) initial barriers, (2) trip barriers, and (3) destination barriers. Attitudes about bicycling, topography, distance, and physical fitness make up the first tier. Perceived safety levels are by far the most significant trip barrier at the second tier. Lack of facilities at trip destinations represent the third tier; for example, a rigid dress code or lack of adequate bicycle parking and showers.

While dismantling many of these barriers would require long-term approaches (e.g., land use regulation), bicycle safety can be improved through proper facility design. Recreational cyclists and the general public consistently cite safety hazards as a critical deterrent to utilitarian cycling.

New local data gathered by the Innovations Unit of the Washington State Transportation Commission confirm that Seattle residents are also concerned about their level of safety when bicycling. The Innovations Unit surveyed Puget Sound area employers to determine employee willingness to consider bicycling, deterrents to bicycle commuting and safety perceptions of various bicycle facilities. Of the 526 respondents, 68 percent indicated that they would not consider biking to work. Among these respondents, the most commonly cited deterrents were "live too far away," "do not own a bike," and "weather is too bad." Respondents who indicated a willingness to consider bicycle commuting (32 percent) were asked to rate facilities based on their perceptions of the facility's safety rating. Barrier-separated paths and lanes were rated as "definitely safe"; bike lanes and signed paved shoulders were rated as "somewhat safe"; and, unsigned shoulder and no shoulder routes were rated as "definitely not safe."

## FACILITY DESIGN ISSUES: A SAFETY EMPHASIS

Given that unsafe bicycling conditions present a significant barrier to utilitarian cycling, a logical step in encouraging more bicycle use would be to create safer conditions though better facility design. Bicycle advocates argue over the safety levels and general appropriateness of different off- and on-street facilities. While off-street facilities are perceived to be safer by many different users, some research points out that some types of paths are in fact more dangerous than on-street bicycling. On the other hand, bicycle lanes are also controversial in that the lanes could create a false sense of security for those inexperienced with riding in traffic. In any case, sidewalk bicycle facilities are discouraged because they are associated with high accident rates involving pedestrians on sidewalks and motor vehicles in driveways.

Off-street facilities are mainly Class I separated multi-use paths and trails and in some cases are converted from rail rights-of-way. [Class designations come from the Washington State Department of Transportation *Design Manual.*] Design recommendations for such facilities focus on mitigating multiple use conflicts, ranking geometric safety over scenic beauty, and paying special attention to traffic crossings.

Examples of on-street facilities are Class II bike lanes and Class III signed bicycle routes. On-street facilities are important for bicyclists because, although paths are popular and perceived as safe, political and financial constraints prevent local and state governments from constructing complete off-street bicycle networks. Design recommendations for on-street facilities include 4-foot wide striped bike lanes or 15-foot wide travel lanes (with room for bicycle and automobile to pass). Several traffic engineering measures to improve on-street bicycle conditions are also discussed, including bicycle-activated loop detectors, bicycle-friendly traffic signal timing, and signage to discourage wrong-way riding.

## FUNDING FOR BICYCLE PROJECTS

The potential for obtaining federal funding for off- and on-street bicycle transportation projects has never been better, according to *USDOT Case Study no. 5 An Analysis of Current Funding Mechanisms for Bicycle and Pedestrian Programs at the Federal, State, and Local Levels.* ISTEA represents a clear departure from "business as usual" highway spending to give state governments and MPOs authority to flex transportation monies across funding programs and to emphasize Intermodalism. ISTEA Title I-Surface Transportation contains the most opportunities for bicycle projects with new funding categories such as the Transportation Enhancements Activities program and the Congestion Mitigation and Air Quality program. The Innovations Unit surveyed MPOs around the country to determine whether and how they were spending money on bicycle projects. Appendix B outlines how selected MPOs allocated ISTEA funds for bicycle projects, according to their 1993 Transportation Improvement Programs, and Appendix C describes innovative means by which local and state governments fund bicycle projects.

## CONCLUSION

This report emphasizes the important connection between various bicycle facilities and funding opportunities afforded by ISTEA, state and local sources. It is hoped that the USDOT goals to encourage bicycle transportation can be met through better facility design and increased attention to and funding of bicycle projects.

# Acknowledgments

The authors gratefully acknowledge the support of the Washington State Transportation Commission, and the many people and organizations in the public and private sectors who provided us with information. Valuable contributions to the final preparation of this report were made by the staff of the Washington State Transportation Center (TRAC) at the University of Washington.

# Introduction: The Relevance of Utilitarian Bicycling

Traffic congestion, environmental degradation, and limited urban mobility are among the transportation-related problems that adversely affect the nation's economic health as well as Americans' quality of life. Cognizant that no single transportation improvement can solve all of these problems, the federal government has expressed vigorous new interest in increasing levels of walking and bicycling. This interest is evident in many sections of the landmark Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which offers unprecedented opportunities and flexibility for funding bicycle projects. Another tangible indication of the federal government's interest in bicycling is the recent publication of a U.S. Department of Transportation report entitled *The National Bicycling and Walking Study* (USDOT 1994). Commissioned by Congress, this $1 million study was organized around the two-pronged goal of doubling the current percentage of bicycling and walking trips nationwide (from 7.9 percent to 15.8 percent), while reducing by 10 percent the number of injury and fatality accidents caused by automobile crashes with bicyclists and pedestrians. As the federal study points out, nonmotorized modes are associated with significant public health, environmental, and transportation benefits, including the following:

**Public health benefits**

- Reduced risk of coronary disease, stroke, and other chronic illnesses
- Reduced health care costs
- Contribution toward greater personal mobility and independence in later years of life

**Environmental benefits**

- Less pollution because of reduced congestion and vehicle miles traveled
- Green space preservation as a result of separated bikeway construction

**Transportation benefits**

- Additional travel options for nondrivers
- Reduced frequency of certain types of motor vehicle crashes thanks to roadway improvements that accommodate bicycles, such as the addition of paved shoulders
- Improved motor vehicle safety due to traffic-calming measures, in residential or downtown shopping and business areas

*The National Bicycling and Walking Study*, which consists of 24 empirically-rich case studies and a summary volume, identifies barriers to nonmotorized travel, as well as strategies for removing them (including a discussion of actual and potential funding sources). Prepared as a practical guide for policy makers, the summary volume sets forth an action plan with elements at federal, state, and local levels. If the study has a drawback, it is that the summary volume's broad generalizations are thinly substantiated by empirical evidence. On the other hand, the 24 case studies upon which the summary volume is based, are richly detailed and well documented. However, these case studies are dense.

Therefore, the first purpose of this report is to bridge the gap between the empirically thin summary volume and three of the data-rich case studies. The second purpose is to supplement the federal study with background information on ISTEA and new primary data on how metropolitan planning organizations (MPOs) are allocating some of their ISTEA funding to bicycle projects. The third purpose is to present new data from the Puget Sound region regarding perceptions of bicycle safety. Given the federal government's demonstrated interest in increasing bicycle travel, coupled with the availability of sizable, flexible appropriations, it is a particularly opportune time to consider ways to enhance bicycle travel in Washington state.

While the federal study is comprehensive, this report focuses on a single, salient theme: bicycle safety. Safety is arguably the most formidable barrier to utilitarian cycling that is amenable to short-term and long-term policy interventions. Distance, for example, is probably a greater deterrent, but changing the nation's land-use patterns, which favor suburbanization and long commute distances, would be a Herculean task. Hilly terrain and harsh weather are likewise major barriers, but resistant to policy solutions. Safety concerns are high on the list of barriers; but unlike distance or topography, policy makers can address these concerns by constructing or improving bicycling facilities, by educating bicyclists and drivers, and by enforcing the rules of the road. Consequently, this report overviews elements of three of the 24 case studies prepared for the federal study:

*Case Study No. 1, Reasons Why Bicycling and Walking Are and Are Not Being Used More Extensively as Travel Modes*, by Stuart A. Goldsmith (1992);

*Case Study No. 4, Measures to Overcome Impediments to Bicycling and Walking*, by Zehnpfenning et al. (1993); and,

*Case Study No. 5, An Analysis of Current Funding Mechanisms for Bicycle and Pedestrian Programs at the Federal, State, and Local Level* (1993) by the Bicycle Federation of America.

# 1. Safety Concerns as a Deterrent to Utilitarian Bicycling

## Bicycling in the United States: Current Levels and Demographic Breakdowns

Despite its popularity for recreational purposes, cycling accounts for a minute percentage of Americans' overall trips. In fact, the 1990 Nationwide Personal Transportation Study, which sampled 22,317 households nationwide, found that cycling trips accounted for only 0.7 percent of all trips, and that this percentage had not risen since 1983, when the last survey was carried out (Research Triangle Institute 1990). Goldsmith (1994) compiles the results of seven separate surveys, all of which show that the vast majority of bicycle trips are recreational, rather than utilitarian in nature (Table 1).[1]

Goldsmith explains why so few Americans use their bicycles to commute:

> Those things most widely associated with bicycling—exercise, recreation, and environmental protection—are far from the minds of most commuters. Conversely, the things which inspire commuters in their mode selection—travel time, convenience, the need for a car during the day—are not advantages ordinarily associated with bicycles (1992, 19).

## The Demographic Characteristics of Bicyclists

**Age.** Of the demographic factors commonly considered in conjunction with cycling, age bears the strongest statistical correlation. Citing Goldsmith and the Harris Poll, Niemeier and Rutherford (USDOT 1994) note that, "propensity to cycle declines as one ages." Goldsmith's *Case Study no. 1, Reasons Why Bicycling and Walking Are and Are Not Being Used More Extensively as Travel Modes*, reveals that at least two-thirds of the cycling population are under the age of 45 and that the rate drops precipitously past that age.

The particularly high percentage of cyclists ages 16 to 25 in Boulder (43 percent) is notable and attributable to Boulder's status as a university town. According to Goldsmith, "University towns have higher levels of bicycle commuting. The obvious explanation is that there is a large population of young, healthy people living within a reasonable distance of campus who may dress as they please" (1994).

**Sex.** New data at the local level indicate that bicyclists are predominantly male (Table 2). "These findings are also consistent with recent count data taken on citywide commuter routes in Phoenix (Cynecki et al. 1993) in which men accounted for approximately 75 percent of the observed bicyclists" (Niemeier and Rutherford 1994).

**Table 1. Percentages of Active Bicyclists Using Bicycle for the Following Purposes vs. Percentages of All Respondents Deeming the Bicycle Appropriate for Such Trips**
(Source: *Attitude Study for the Portland Metropolitan Bicycling Encouragement Program*; cited in Goldsmith 1994, 17)

| Purpose | Bicycle Use: Active Cyclists | Believe Appropriate for Bicyclists: All Respondents |
|---|---|---|
| **Work** | 12.2% | 87.6% |
| **School** | 2.8% | 95.6% |
| **Utility** | 26.1% | 82.5% |
| **Recreation** | 95.6% | 99.5% |
| **Shopping** | N/A | 49.7% |

**Table 2. Percentages of Adult Bicyclists by Sex**
(Source: Goldsmith 1994, 14)

| | Harris Poll | NPTS 1990 | FHWA RD-80 | Seattle |
|---|---|---|---|---|
| **Male** | 57% | 75% | 67% | 54% |
| **Female** | 43% | 25% | 33% | 46% |

**Income and Employment.** Propensity to bicycle declines as income rises. Again, citing Niemeier and Rutherford, "In a study of downtown bicycle work trips, Lott et al. (n.d., 32), found that commuting cyclists were more heavily represented in the employment categories of sales, clerical, service, and laborer than those in professional or technical positions." On a similar note, Ashley and Banister (1989) found that higher social classes in England tended to make fewer cycling trips.

## Impediments to Bicycling as a Travel Mode

Why is utilitarian cycling so rare, when Americans have such a hearty interest in recreational bicycle use? Mode choice is a complex phenomenon influenced by many considerations, such as distance, convenience, safety, and many others. Goldsmith organizes the barriers into a three-tiered hierarchy consisting of (1) initial considerations, (2) trip barriers, and (3) destination barriers (fig. 1). These tiers are overviewed in the following section.

### Initial Considerations

#### Attitude

The USDOT report notes that attitude is an underlying barrier to use of bicycling as a travel mode. To put it bluntly, few Americans even consider cycling to be a means of transportation, as opposed to a leisure pursuit. Automobile travel, even for very short trips, is the culturally entrenched status quo, and as such, the first and often only option that crosses most Americans' minds. The USDOT report contends that "People may choose not to bicycle or walk because they perceive these activities as "uncool," as children's activities, or as socially inappropriate for those who can afford a car"

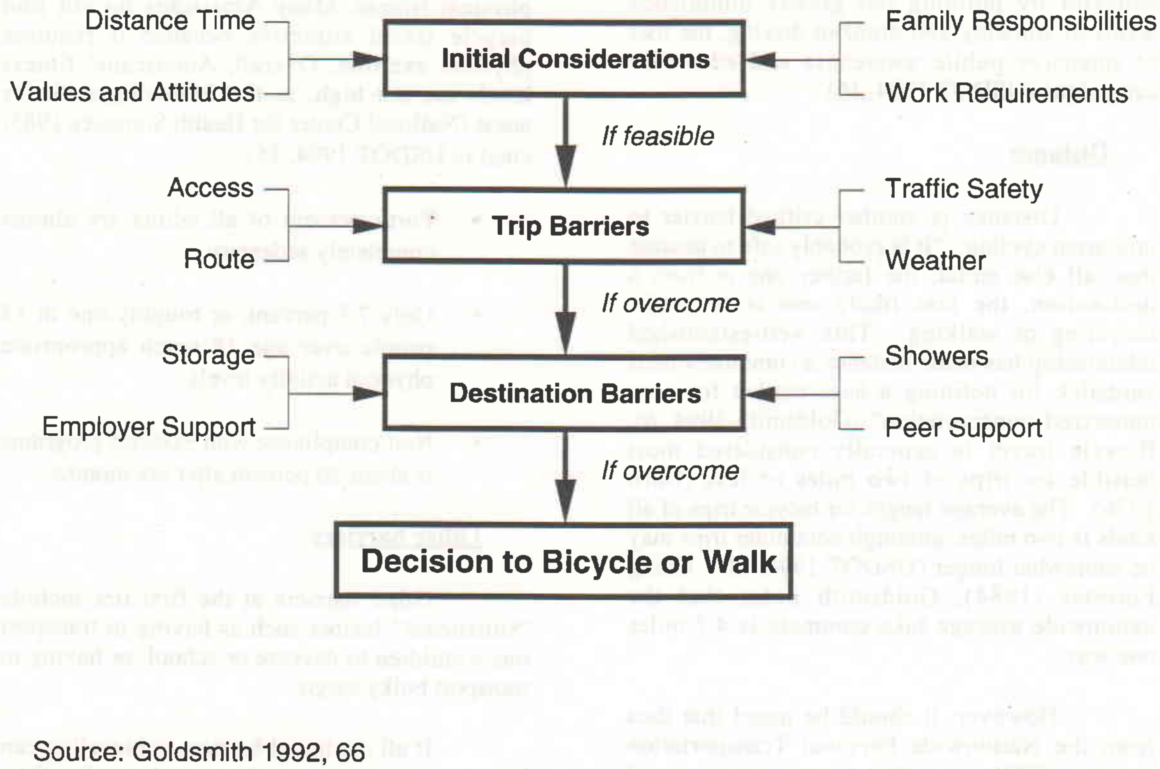



**Figure 1. Barriers to bicycle commuting**

(USDOT 1994, 23).[2] Consequently, the USDOT report advocates raising public awareness of bicycling as a travel mode through public relations programs, one example of which would be bike-to-work days. The federal report hints at the malleability of social norms and associated behavior by pointing out greatly diminished levels of smoking and drunken driving, the foci of intensive public awareness and education campaigns (USDOT 1994, 16).

**Distance**

Distance is another critical barrier to utilitarian cycling. "It is probably safe to assume that, all else equal, the farther one is from a destination, the less likely one is to prefer bicycling or walking. This well-established relationship has made distance a commonly used yardstick for defining a base market for non-motorized transportation" (Goldsmith 1994, 6). Bicycle travel is generally considered most feasible for trips of two miles or less (Ohrn 1976). The average length for bicycle trips of all kinds is two miles, although commuter trips may be somewhat longer (USDOT 1994, 11). Citing Forester (1984), Goldsmith notes that the nationwide average bike commute is 4.7 miles one way.

However, it should be noted that data from the Nationwide Personal Transportation Survey (1990) reveal that a large percentage of the vehicle trips made by Americans are, in fact, within easy biking distance. Trips of three miles or less make up 49 percent of the total number of trips, and trips of five miles or less make up 63 percent of the total.

Although biking may not be a feasible *commute* mode because of distance, dress requirements, and other considerations, commute trips represent a small minority (20 percent) of total trips (Pisarski 1987). Goldsmith points out the large potential for increasing the use of nonmotorized modes for the 80 percent of trips that are not work-related, "The largest proportion of trips relate to family and personal business or are social and recreational trips. These non-work trips may actually be the most amenable to bicycling or walking as travel modes, since they often do not face the same rigid constraints in terms of distance, attire, urgency, time of day, etc" (1992, 29).

**Physical fitness**

Related to distance as a barrier is physical fitness. Many Americans do not find bicycle travel attractive because it requires physical exertion. Overall, Americans' fitness levels are not high, as the following statistics attest (National Center for Health Statistics 1985; cited in USDOT 1994, 15):

- Forty percent of all adults are almost completely sedentary.
- Only 7.5 percent, or roughly one in 13 people over age 18 reach appropriate physical activity levels.
- Non-compliance with exercise programs is about 50 percent after six months.

**Other barriers**

Other barriers at the first tier include "situational" factors such as having to transport one's children to daycare or school, or having to transport bulky cargo.

If all the initial barriers to bicycling can be overcome, then a trip is at least feasible. However, obstacles at the second tier, "trip barriers," may still keep people from traveling by bicycle.

## Trip Barriers

**Perceived safety**

Perceived safety is by far the most significant barrier at this tier. Because they are concerned about heavy or fast-moving traffic, aggressive drivers, narrow lanes, insufficient shoulders, exhaust fumes, and other hazards, many Americans, avid recreational cyclists included, do not consider utilitarian cycling to be safe under prevailing circumstances. An extended discussion of this barrier comes later in this chapter.

---

[2] However, it is notable that neither the summary volume, nor the case study upon which it is based, cites any research to substantiate this claim.

**Poor access and linkage**

Poor access and linkage in the network of bicycling facilities constitute another trip barrier insofar as they prevent bicyclists from making their trips via short, safe, direct routes.

> A beautifully designed and constructed off-road facility is useless to the bicyclist or pedestrian who cannot traverse a narrow bridge or cross a freeway to get to it. Similarly, facilities that do not connect neighborhoods to shopping areas or downtown businesses may never achieve their intended purpose of increased use of non-motorized travel modes (Goldsmith 1991, 25).

**Environmental barriers**

Environmental barriers include hills, darkness, pavement quality, fear of crime, extreme temperatures, and other adverse weather conditions.

## Destination Barriers

Even those who are able to overcome obstacles at the first two tiers may face barriers at the endpoint of their trips. Such destination barriers may include unsupportive work environments, such as subtly or overtly discouraging colleagues, inflexible work hours, rigid dress code and/or lack of showering and changing facilities. According to a USDOT report, secure parking merits special attention.

> A Baltimore survey of bicyclists reported that 25 percent had suffered theft, with 20 percent of those giving up bicycling as a result. In New York, bicycle theft numbers in the thousands annually. Even when parked securely, bicycles are frequently exposed to damage from rain and other environmental conditions (USDOT 1994, 25).

## The Potential for Bicycle Commuting

As noted in the preceding discussion, many barriers, chief among which are distance, safety concerns, hilly terrain, and adverse weather, deter most Americans from utilitarian bicycling. Any single barrier at any of the three tiers can be enough to keep someone from traveling by bicycle. Many people are, of course, deterred by two or more.

As Goldsmith (1994) points out, these barriers vary in terms of their amenability to both short-term and long-term solutions. Distance, for example, is not amenable to short-term policy solutions because this barrier is inextricable from the spatial orientation of America's cities, suburbs, and edge cities.[3] A net result of Americans' land use preferences and policies is a tendency to travel great distances to work. Jackson (1985) and Zehnpfenning et al. (1993, 5) attribute Americans' affinity for suburban sprawl to a long-standing, deeply felt anti-urban bias:

> City dwelling was seen as undesirable due to noise, overcrowding, and poor health conditions. The prevailing image of urban neighborhoods was one of immorality and vice, where one found people of lower character...Commuter railroads and streetcars, as well as horses and private carriages, allowed first the wealthy, and then the middle class to flee the city while maintaining access to employment, shopping, and cultural facilities.

The outcome of this long-term bias has been low-density suburban development combined with zoning laws that dichotomize residential and industrial land uses—which results in lengthy commute distances. Dismantling the distance barrier, in essence changing Americans' entrenched land use preferences and policies, would be extremely difficult.

Similarly, there is little that policy makers can do about some environmental factors, such as extreme weather or hostile topography. Nonetheless, one of the most significant barriers, safety concerns, *is* amenable to policy solutions. We will explore the notion that perceived safety hazards constitute a barrier to higher levels of utilitarian cycling in the

---

[3] A greatly simplified definition of edge cities would characterize them as employment centers located beyond central business districts (Garreau 1991).

following section, which supplements the federal study findings (USDOT 1994) with new data from the Puget Sound area.

## Safety Concerns as a Barrier to Utilitarian Bicycling

Safety is a barrier that merits a separate, extended discussion for several reasons. First, bicyclists and pedestrians account for a goodly percentage of the injuries and fatalities due to roadway accidents.

1991 data from the Fatal Accident Reporting System (FARS) indicate that 6,595 pedestrians and 841 bicyclists were killed in crashes involving motor vehicles (U.S. DOT 1992). In addition, an estimated 109,000 pedestrians and 77,000 bicyclists were injured in motor-vehicle-related crashes, based on 1990 General Estimates System data (U.S. DOT 1991). As a group, pedestrians and bicyclists comprise more than 13 percent of all the highway fatalities in Washington state each year (Washington Traffic Safety Commission 1994). In 1992, for example, eight cyclists and 80 pedestrians were killed in crashes with motor vehicles, out of a total of 661 highway fatalities.

In any case, it is important to recognize that comparing the safety of utilitarian bicycling to motor vehicle travel is complicated by several factors. First, a large percentage of the victims of bicycle-motor vehicle accidents are children making recreational trips. Boys, who tend to cycle more than girls, are most often the victims. In Washington state in 1991, boys between the ages of five and 14 accounted for 33 percent of non-fatal hospitalizations and fully 39 percent of deaths due to bicycle crashes (Gebbie 1992, 1-2). Nationwide, in 1991, children between the ages of five and 15 accounted for one-third of the fatalities in crashes involving bicycles and motor vehicles. The fatality rate for children age five to 15 was *double* the rate for cyclists overall: the fatality rate for children in this age group was 7.4 fatalities per million, while the fatality rate for cyclists overall was 3.3 per million (National Center for Statistics and Analysis 1992). While the large number of accidents involving children is a serious issue that merits attention, it is important to bear in mind that the inclusion of these accidents in any analysis of the utilitarian bicycling safety for adults would be misleading.

Another point to keep in mind is that accident rates among adults range widely, depending on the bicyclist's skill and experience. Inexperienced bicyclists account for a disproportionately high percentage of accident victims. Forester (1993) cites several studies that show an inverse correlation between bicycling experience and accident rates (Kaplan 1975; The British Cyclists' Touring Club 1984; Cross 1980).[4] Forester asserts,

> Car-bike collisions do occur to competent cyclists, but these are much less frequent than those to average bicycle riders, and they are basically similar to motorist-motorist collisions. They are caused by general mistakes in driving, not by the peculiarities of cyclists. Unfortunately, most car-bike collisions are caused by cyclists of low skill committing the most elementary kinds of mistakes: mistakes in which they disobey the law, which implies a very low level of skill in traffic cycling (1993, 250).

*Perceived* safety hazards are a related issue. Recreational cyclists and the general public consistently cite safety hazards as a critical deterrent to utilitarian cycling (Table 3). Pointing out that "...the data again and again point to the same concerns," Goldsmith (1994, 19) pulls together survey data from several studies to demonstrate the ongoing, nationwide salience of perceived safety hazards as a barrier to utilitarian cycling (1991, 20).

Goldsmith also reports a *Bicycling Magazine* poll (1991) that asked avid cyclists who had not commuted to work by bicycle the following question: "Do you think you would sometimes commute to work by bicycle if there were..." (Table 4).

These data are interesting because avid bicyclists, as opposed to the population at large, have a more realistic sense of the danger of bicycle travel. Ostensibly, because of their interest in cycling, it seems plausible that avid recreational bicyclists would be the group most likely to shift to utilitarian bicycling if safety conditions were improved.

---

4 Unfortunately, Forester's citations are incomplete; as such, these sources could not be included in the references to this report.

**Table 3. Percentage of All Respondents Citing Traffic Safety as Influential in Decision not to Cycle**
(Source: Goldsmith 1994, 20)

| Factor | Boston | Gainesville | Portland | Vancouver B.C. |
|---|---|---|---|---|
| Traffic Safety | 53% | 73% | 55% | 35% |

**Table 4 *Bicycling Magazine* Harris Poll**
(Source: Goldsmith 1994, 21)

| Improvement | Active Riders' Response |
|---|---|
| Safe Bike Lanes | 49% |
| Financial Incentives | 44.5% |
| Showers and Storage | 43.5% |
| Rise in Gas Prices | 38% |

In addition to the evidence on stated preferences or incentives that would impel people to shift modes, it is also instructive to move beyond what people *say* would induce them to shift modes and look at actual bicycling levels as a function of the presence of relatively safe cycling facilities. Goldsmith (1994) does this by plotting the ratio of bike lanes to arterial miles against the percentage of bicycle commuters in 18 American cities (fig. 2). According to *Bicycling* magazine, some of these cities are considered to be bicycle-friendly (Davis, California, and Eugene, Oregon) and some are considered to be particularly bicycle-unfriendly (New York City and Orlando, Florida) (*Bicycling* magazine 1990).

Goldsmith explains the value of this analysis:

> An even better gauge of utilitarian commuting may be found in the ratio of arterial/collector miles to bike *lane* miles. Bicycle commuters must often travel on major thoroughfares to reach work destinations in high density areas. It is the perceived danger associated with such travel that scares off many potential bicycle commuters. Bike lanes are designed to provide a modicum of security to the bicyclist on heavily traveled streets. If this is true, cities with a relatively high proportion of bike lanes to arterial miles should also have higher levels of bicycle commuting (1994, 39).

When Goldsmith averaged the values for all of the cities, he found that cities with fewer than 0.035 miles of bike lanes per mile of arterial had an average bicycle commute rate of 0.63 percent, a low value. On the other hand, cities with more than 0.035 miles of bike lanes per mile of arterial had a bike commute rate more than *ten times* higher: fully 6.8 percent (Table 5).

However, as noted previously, the presence of university towns, such as Davis, Boulder, Gainesville, and Eugene, skews the average upward, for reasons that include, but are not limited to the prevalence of bicycle lanes. Because cycling patterns in university towns are idiosyncratic, Goldsmith reanalyzed these ratios without the university towns included (fig. 3). After the university towns were pulled out, the tenfold difference in bicycle commuting was replaced by a more modest, but still significant, threefold difference (Table 6).

Seattle was found to have 0.031 miles of bikeway per arterial mile, a modest number of bike lane miles compared to cities like Tucson,

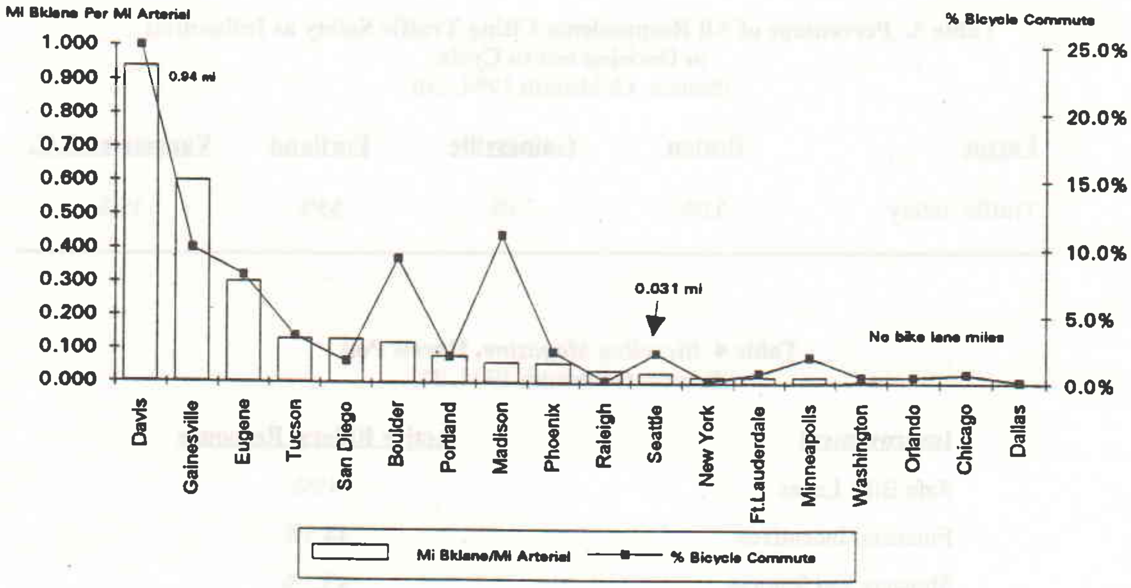



Figure 2. Ratio of Bike Lane to Arterial Miles vs. % Bicycle Commute
(Source: Goldsmith 1994, 41)

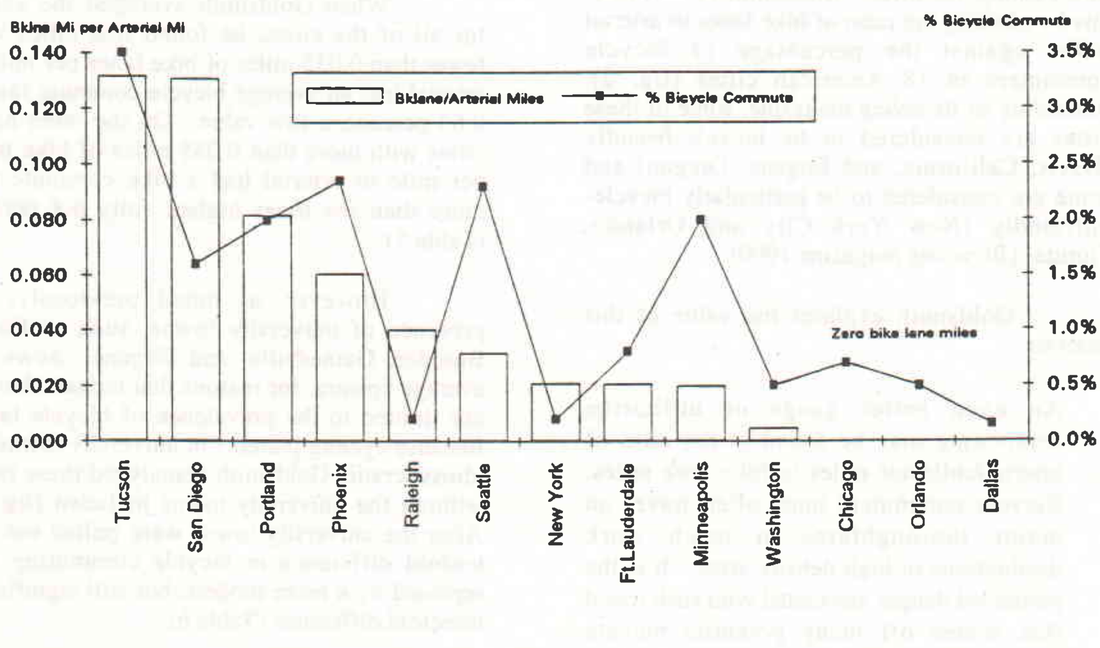



Figure 3. Ratio Bike Lane to Arterial Miles vs. % Bicycle Commute
(University towns excluded)
(Source: Goldsmith 1994, 40)

**Table 5. Average Proportion of Commuter Bicyclists by Bike Lane/Arterial Ratio**
(Source: Goldsmith 1994, 40)

| Ratio of Bike Lane Miles to Arterial Miles | Proportion of Bicycle Commuters (average) |
|---|---|
| Less than 0.035:1 | 0.63% |
| Greater than 0.035:1 | 6.8% |

**Table 6. Average Proportion of Commuter Bicyclists by Bike Lane/Arterial Ratio (University towns excluded)**
(Source: Goldsmith 1994, 41)

| Ratio of Bike Lane Miles to Arterial Miles | Proportion of Bicycle Commuters (average) |
|---|---|
| Less than 0.035:1 | 0.63% |
| Greater than 0.035:1 | 1.96% |

San Diego, Portland and Phoenix, which boast between .06 and .133 bike lane miles per arterial mile. However, at 2.4 percent, Seattle's bicycle commute rate is quite high. Excluding the university towns, the only cities that Goldsmith found to have higher percentages of bicycle commuters were Phoenix and Tucson, whose arid, sunny climates are more conducive to bicycling. Goldsmith does not speculate as to the reasons for Seattle's high bicycle commute rate, but he does conclude that "cities with very few or zero miles of bike lanes are not generating much interest in bicycle commuting" (1992, 41). Later, he goes on to note that "cities with higher levels of bicycle commuting have on average 70 percent more bikeways per roadway mile and six times more bike lanes per arterial mile" (1994, 55). [5]

[5] Goldsmith also discusses the possibility that rather than causing higher levels of bicycle commuting, arterial bike lanes may simply *reflect* the lobbying efforts of an active bicycling community "...A growing bicycle market may well have preceded and inspired construction of such facilities" (1992, 56).

# Perceptions of Cycling Safety at the Local Level: New Data

New local data, gathered by the Innovations Unit of the Washington State Transportation Commission indicate that Seattleites too, are deterred from utilitarian cycling by safety concerns. With the potential for additional bicycle commuting in mind, the Innovations Unit conducted a survey to shed light on local deterrents to bicycle commuting and to explore perceptions of bicycle safety and facilities in detail.

## Survey Design and Administration

Innovations Unit researchers surveyed employers in the Puget Sound region selected from a list compiled by the Puget Sound Regional Council (PSRC), the region's metropolitan planning organization. On the PSRC's list are organizations whose staffs include employee transportation coordinators (ETCs). Because respondents were self-selecting rather than sampled randomly and because the number of organizations and employees surveyed was small, findings are not generalizable to other regional employers. Nonetheless, the results are interesting insofar as they provide insight into local attitudes and detail with regard to the specific of bicycle facilities respondents believed to be safest.

ETCs at six Puget Sound area employers, five in Seattle and one in Kent, agreed to take part in the survey. The employers varied along a number of parameters: location, number of employees, and the nature of the business (e.g., light manufacturing, professional services, public administration). Thumbnail sketches of the employers surveyed are provided in Table 7.

Self-administered questionnaires were distributed to employees between February 11 and March 10, 1993. Some ETCs reminded employees to complete and return their surveys by making intercom announcements and by sending out notices. The response rate ranged from a low of 33 percent at Impression NW to a high of 68 percent at AVTECH. Because survey respondents were asked to indicate their age, sex, and occupational status, it was possible to compare the respondents' demographic characteristics to the employers' overall profiles. This comparison confirmed that survey respondents were representative of their organizations as defined by these basic demographic characteristics.

## Findings

**Willingness to consider bicycling.** Respondents were asked whether they would consider riding a bicycle to work at some point in the future. Of the 526 respondents, 32 percent indicated that they would consider cycling to work. The majority, 68 percent, indicated that they would not consider riding to work.

**Deterrents to Bicycle Commuting.** Respondents were asked to rate various deterrents to bicycle commuting along the following continuum: no effect, minor effect, major effect, and primary effect. In analyzing this group of responses, the researchers divided respondents into two categories: (1) those who indicated that they *would* consider commuting by bicycle, and (2) those who would not (fig. 4). Although the two groups' ranking of deterrents were similar, there were some differences. For example, among those who *would not* consider commuting by bicycle, the most commonly cited primary deterrents were "live too far away," "do not own a bicycle," and "weather is too bad." However, among those who *would* consider commuting by bicycle, "no safe bicycle path" was a primary deterrent.

The responses were thus separated because the concerns of people who are at least willing to consider cycling are more relevant to the issue of how to encourage mode-shifting behavior. Given the minute percentage of Americans who currently commute by bicycle, it seems clear that many people would never cycle to work, regardless of distance, safety, or convenience. Presumably, respondents who indicated that they would not consider cycling to work would be among this group. Even if all of this group's professed concerns could be addressed, the prospect of their shifting from automobile to cycling modes would appear to be dim. On the other hand, it does seem reasonable to infer that people who are already interested in cycling would be more likely to shift modes if the barriers they perceive as impeding them were removed.

**Safety.** Because other studies have revealed that safety concerns constitute a major deterrent to bicycle commuting (University of North Carolina 1991; Pena 1992), this survey sought to clarify perceptions of specific facility types. In other words, what sort of roadways and surfaces do potential bicycle commuters perceive as most dangerous? As safest?

Respondents who indicated a willingness to consider commuting by bicycle were asked to rate facilities along a continuum, ranging from "definitely not safe to commute upon" to "somewhat safe to commute upon" to "definitely safe to commute upon." They were asked to evaluate the following types of facilities:

- Bicycle lane separated from traffic by paint stripe
- No bicycle lane/ride with traffic on four-foot shoulder
- Bicycle lane separated from traffic by barrier
- No bicycle lane/ride with traffic, no shoulder

**Table 7. Thumbnail Descriptions of Employing Organizations Surveyed as to Perceptions of Bicycle Safety**

| Employer | Description | Employees | Location | Bicycle Access | Bicycle-friendly Amenities |
|---|---|---|---|---|---|
| AVTECH | Designs and manufactures electronic equipment | 275 | North Seattle | Close to the Burke-Gilman Trail | Showers<br>Flextime<br>Relaxed dress<br>Indoor bicycle storage |
| Chiyoda International Corporation | Engineering design and construction management | 120 | Downtown Seattle | No marked bicycle facilities leading directly to site | Bicycle parking<br>Flextime<br>Relaxed dress<br>Motor vehicle parking costs $90/month |
| Impression NW | Commercial graphics | 163 | South Seattle | No marked bicycle facilities leading directly to this site | Showers<br>Flextime |
| Pacific Pipeline | Wholesale book distributor | 130 | Kent (a suburb south of Seattle) | No marked bicycle facilities leading directly to this site, and street access is limited | Bicycle racks<br>Indoor storage<br>Clothing lockers<br>Relaxed dress<br>$25/month travel incentive for non-SOV commuters |
| Port of Seattle | Maritime port administration | 322 | Downtown Seattle Waterfront | A bicycle path leads to this site, but employees would have to ride through downtown traffic to reach the building | Showers<br>Lockers<br>Changing facilities<br>Flextime<br>Relaxed dress<br>Guaranteed ride home<br>Fleet cars for business use |
| Washington Dental Service | Manages dental insurance plans | 196 | North Seattle | No safe bicycle path leading directly to this site; but there is some access via side streets | Showers<br>Covered bicycle racks<br>Flextime<br>Relaxed dress on Fridays<br>Guaranteed ride home |

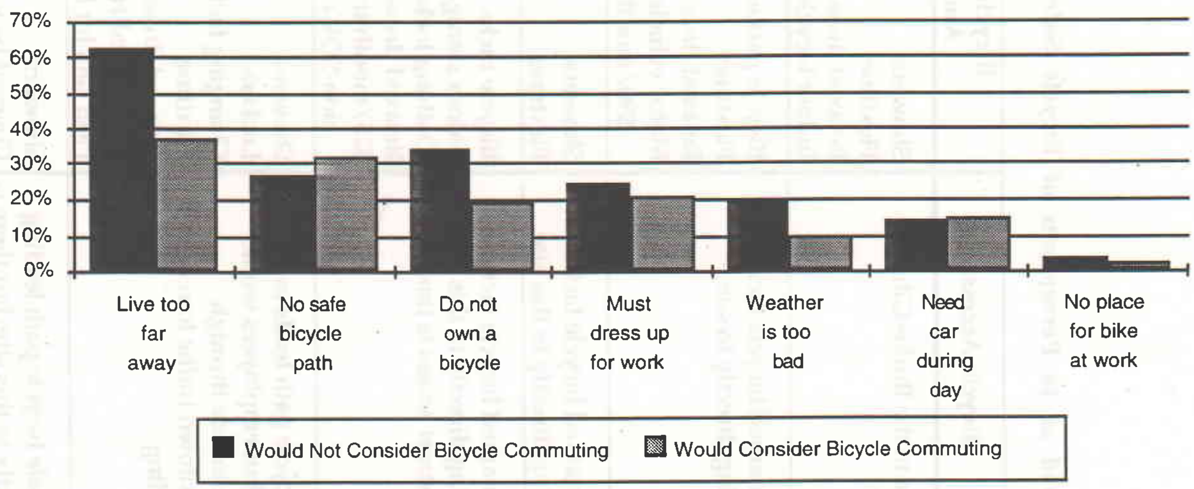



**Figure 4. Primary deterrents to bicycle commuting**

- Signed bicycle route, four-foot paved shoulder

- Separated bicycle path (like Burke-Gilman trail)

Perceptions of the safety of various facility types varied little among the organizations surveyed, indicating basic consensus on this issue. Ninety-one percent of respondents rated a bike path completely separated from motor vehicles, such as the Burke-Gilman trail, as definitely safe to commute upon (Table 8). Bike lanes separated from traffic by physical barriers, such as medians, were rated as definitely safe to commute upon by 86 percent of respondents. A significant drop in perceived safety was associated with the move to a bike lane separated from traffic by a paint stripe, rated as definitely safe to commute upon by only 20 percent of respondents, fully 12 percent of whom felt such facilities were definitely *not* safe to commute upon. Another notch down on the continuum of perceived safety was a signed bicycle route along a four-foot road shoulder. Only 14 percent of respondents perceived such facilities as definitely safe to commute upon; 73 percent perceived them as somewhat safe to commute upon; and 13 percent perceived them as definitely unsafe. Predictably, a four-foot shoulder without any signage was assessed as yet more dangerous. The worst case, no shoulder, riding with traffic, was perceived as definitely unsafe by 94 percent of respondents.

It is interesting that a majority of the respondents considered a *signed* bicycle route on a four-foot shoulders as somewhat safe, while a four-foot shoulder *without signage* was deemed definitely unsafe. This finding warrants further investigation with a more representative sample to study the extent to which clearly designated bicycle lanes encourage cycling, even if they are not separated from traffic.

## Facilities That Encourage Bicycle Commuting

The survey also attempted to determine the extent to which different types of facilities encourage higher bicycle commute rates. The respondents who expressed an interest in cycling were asked to allocate 100 points in increments of their choosing among different facilities to indicate how effective each type of facility would be in encouraging them to commute by bicycle. The assignment of points thus reflects the relative attractiveness of each facility to the respondent. The mean, median, range, and standard deviation of the points assigned to each bicycle facility by the respondents are listed in Table 9.

The importance assigned to safe bicycle lanes was, on average, more than three times higher than any other type of bicycle facility. Showers and lockers at work were the next most important facility, followed by security for bikes, bike racks, and bicycle shelter. Little interest was expressed in linking cycling with bus travel. Two possible reasons are that (1) few respondents use park-and-ride lots, or (2) many people bicycle for exercise, and the trip to a park-and-ride lot may not provide the desired level of exercise.

These local findings support national studies that indicate that concerns about safety are foremost in the minds of people who are willing to consider, but are otherwise deterred from utilitarian cycling. The following chapter takes safety concerns as a barrier to utilitarian cycling as a given and considers one means of removing this barrier: bicycle facility improvement and/or construction. In so doing, the following chapter overviews *Case Study no. 4, Measures to Overcome Impediments to Bicycling and Walking,* by Zehnpfenning et al. (1993).

**Table 8. Safety Ratings for Various Types of Bikeways**

| Bikeway | Rating of Bikeways: Definitely Safe | Somewhat Safe | Definitely Not Safe |
|---|---|---|---|
| Separated bicycle path | 91% | 9% | 0% |
| Bike lane separated by barrier | 86% | 14% | 0% |
| Bike lane separated by paint stripe | 20% | 68% | 12% |
| Signed bicycle route on four-foot shoulder | 14% | 73% | 13% |
| Four-foot shoulder - no signage | 4% | 38% | 58% |
| No shoulder - ride with traffic | 0% | 6% | 94% |

**Table 9. Relative Importance of Bicycling Facilities**

| Bicycle Facility | Median | Mean | Range of Responses | Standard Deviation |
|---|---|---|---|---|
| Safe bicycle lanes | 35 | 38 | 0 - 100 | 24 |
| Showers at work | 10 | 13 | 0 - 80 | 14 |
| Lockers at work | 10 | 9 | 0 - 50 | 9 |
| Security for bikes | 5 | 8 | 0 - 50 | 9 |
| Bike racks at work | 5 | 7 | 0 - 100 | 16 |
| Roof over racks | 5 | 6 | 0 - 40 | 7 |
| Bike racks on buses | 0 | 7 | 0 - 91 | 14 |
| Bike lockers at park-and-ride lots | 0 | 6 | 0 - 80 | 13 |
| Bike racks at park-and-ride lots | 0 | 2 | 0 - 30 | 5 |

# 2. Facility Design Issues: A Safety Emphasis

As demonstrated in Chapter 1, certain types of facilities, principally those that separate cyclists in some way from the traffic flow, are perceived as safest. This perception is supported by Everett and Spencer ([1983], quoted in Zehnpfenning et al. 1993, 91) who found that "a reasonable correlation has been found between increased usage and classes of facilities that allow bicyclists a space to ride out of the constant flow of fast or heavy automobile traffic."

Goldsmith provides additional support for this view:

> ...removing the perceptions of danger and lack of good routes is fundamental to tapping the existing potential of bicycling. If bicycling facilities are designed to allay safety concerns and are linked in such a way that access matches the access motorists have come to expect, then utilitarian bicycling will increase (1994).

Given that recreational cyclists (who plausibly make up the largest group of latent utilitarian cyclists) are deterred by safety concerns, a logical step in removing this barrier is to consider the safety implications of particular facility design configurations. Therefore, this Chapter overviews elements of *Case Study no. 4: Measures to Overcome Impediment to Bicycling and Walking*, by Zehnpfenning et al. (1993), which includes specific recommendations on facility configuration and traffic engineering, among other issues.

Zehnpfenning et al. divide bike facilities into two main types: (1) off-street facilities, such as separated bike paths and sidewalk facilities; and (2) on-street facilities, such as striped bike lanes, wide curb lanes, and hybrid lanes (which combine elements of striped bike lanes and wide curb lanes). The safety implications of each of these main facility types, as well as the specific configurations that constitute each, are compared herein.

## Off-Street Facilities

### Separated Bike Paths

Separated bike paths, such as the Burke-Gilman Trail, are stand-alone corridors wholly removed from traffic, except at crossings (fig. 5). Frequently located along riverfronts, waterfronts, or abandoned railroad alignments, they may serve an additional function of preserving areas of scenic beauty or green space. Separated bike paths are particularly attractive to beginning cyclists, children, and recreational riders, who consider them safe and enjoyable to use. In fact, most recreational trips are made on off-street facilities. With a few notable exceptions (e.g., Forester 1993), these facilities are generally considered safe by transportation researchers.

In terms of safety, a caveat is in order. The presence of inexperienced or inexpert riders, as well as pedestrians, joggers, in-line skaters, and animals, poses particular safety risks. In fact, experienced utilitarian riders may not consider riding on such facilities to be worth the trouble, especially during periods of heavy

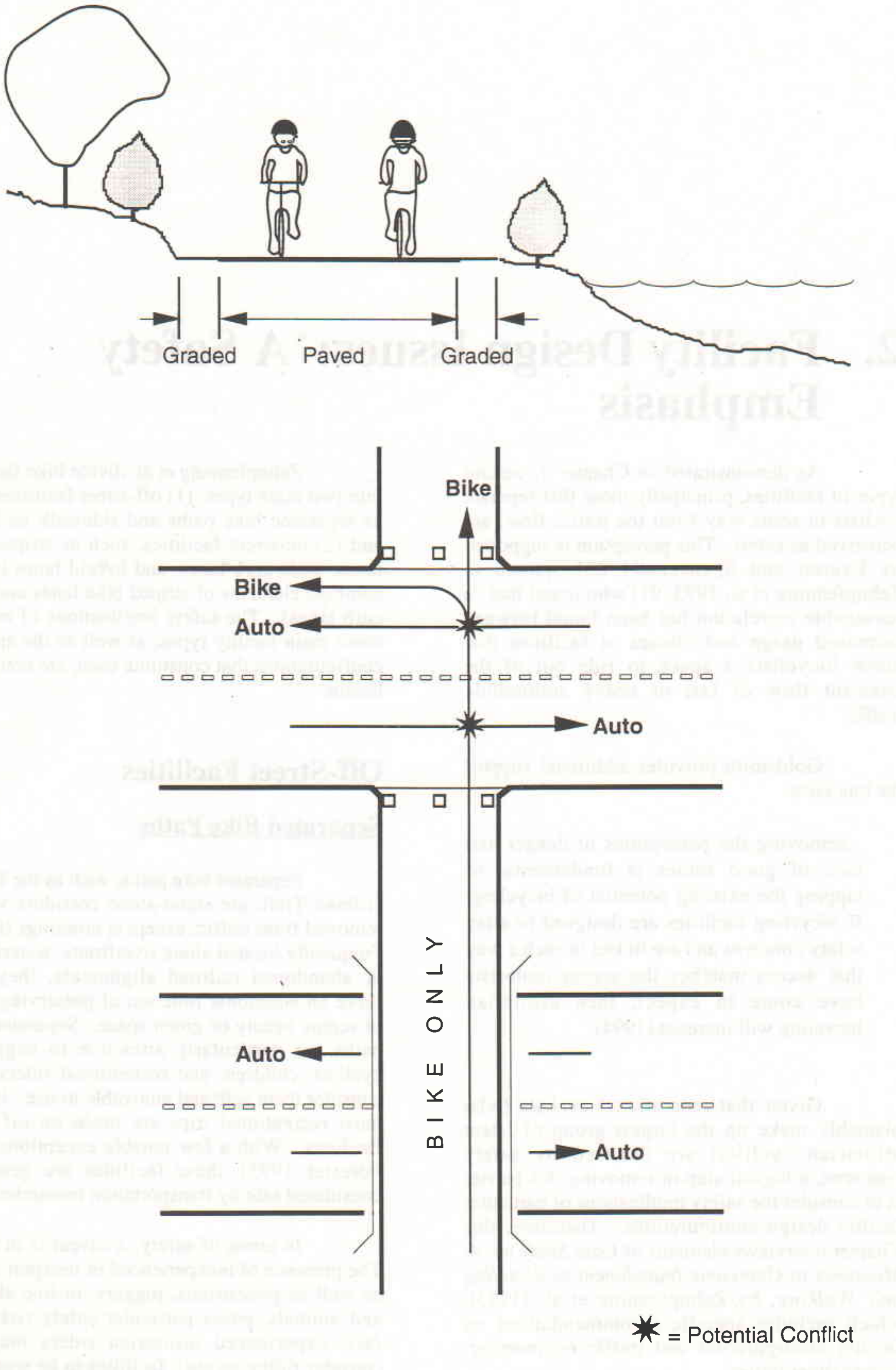



**Figure 5. Separated bike path**

recreational use (Untermann, *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling*, (New York: Van Nostrand Reinhold Company, 1984, 63). Nonetheless, insofar as off-street facilities give new cyclists a safe place to learn to ride and to gain confidence, they serve an important function in building interest in cycling and ostensibly creating a base from which to draw utilitarian cyclists.

Additionally, off-street facilities may be useful for commute and other utilitarian purposes when they provide a direct route between major trip generators, as does the Burke-Gilman Trail, which links north Seattle residential neighborhoods with the University of Washington campus. Zehnpfenning et al.'s recommendations for the safe design of off-street facilities, some of which are quoted from other studies, are listed below:

**Design Recommendations for Separated Bike Paths**

- **Mitigate multiple use conflicts.** "Signage and operation policies should encourage 'sharing the path' safely. Entrances and exits should be designed to require a deliberate stop/look/go, rather than a merging movement, so that bicyclists are not encouraged to enter into cross traffic without looking" (Zehnpfenning et al. 1993, 31).

- **Prioritize geometric safety over scenic beauty.** "Historically, the design of trails in parks and green belts has focused on pedestrian considerations and the trail as a feature of the landscape. Unfortunately, this has led to facilities with grade profile curvatures, sight distances, pavement widths, and pavement surfacing inappropriate for use by bicyclists" (Smith 1982). "Creating parallel paths for users moving at different speeds should be considered when widening an existing path" (Zehnpfenning et al. 1993, 31).

- **Pay special attention to traffic crossings.** "Wherever possible, off-street facilities should be continuous paths without traffic crossings. If crossings cannot be eliminated, they should be well marked. Unexpected traffic crossings can be surprising and dangerous. They should not be built in areas that require frequent at-grade street crossings" (Zehnpfenning et al. 1993, 32).

## Sidewalk bicycle facilities

Although inexperienced cyclists *perceive* themselves to be safer riding on sidewalks (fig. 6) than in traffic, the opposite is true. Because they "increase bike-car conflicts at intersections and are designed for pedestrian speeds, sidewalk bikeways actually make things worse" (Zehnpfenning et al. 1993). Researchers in Eugene, Oregon, found that the accident rate on the city's sidewalk bike routes was close to three times higher than the accident rate on the city's signed lanes or striped lanes (32). Zehnpfenning et al. cite additional evidence against sidewalk facilities from a Palo Alto study that, found that, "although only 15 percent of the bicycle travel occurred on streets with sidewalk bicycle paths, 70 percent of the reported bike motor vehicle accidents on the bikeway system occurred on such streets" (32). Because they are so dangerous, the authors of *Case Study no. 4* recommend that sidewalk bicycle facilities not be constructed at all. Citing Daniel Smith, author of "Planning and Design of Bicycle Facilities: Pitfalls and New Directions" (1982), Zehnpfenning et al. list the problems that make sidewalk bicycle facilities so hazardous.

- **Poor sight distance and visibility at driveways.** Sight distances and visibility at driveways are often poor because landscaping, shrubbery, and fences tend to obstruct vision. Compounding the problem are the poor visual relationships that result when motor vehicles back out of and turn into driveways.

- **Poor sight distance and visibility at intersections.** The emergence of a high-speed bicycle (as opposed to pedestrian speed) into the crosswalk area is often unanticipated by motorists, particularly those completing turns.

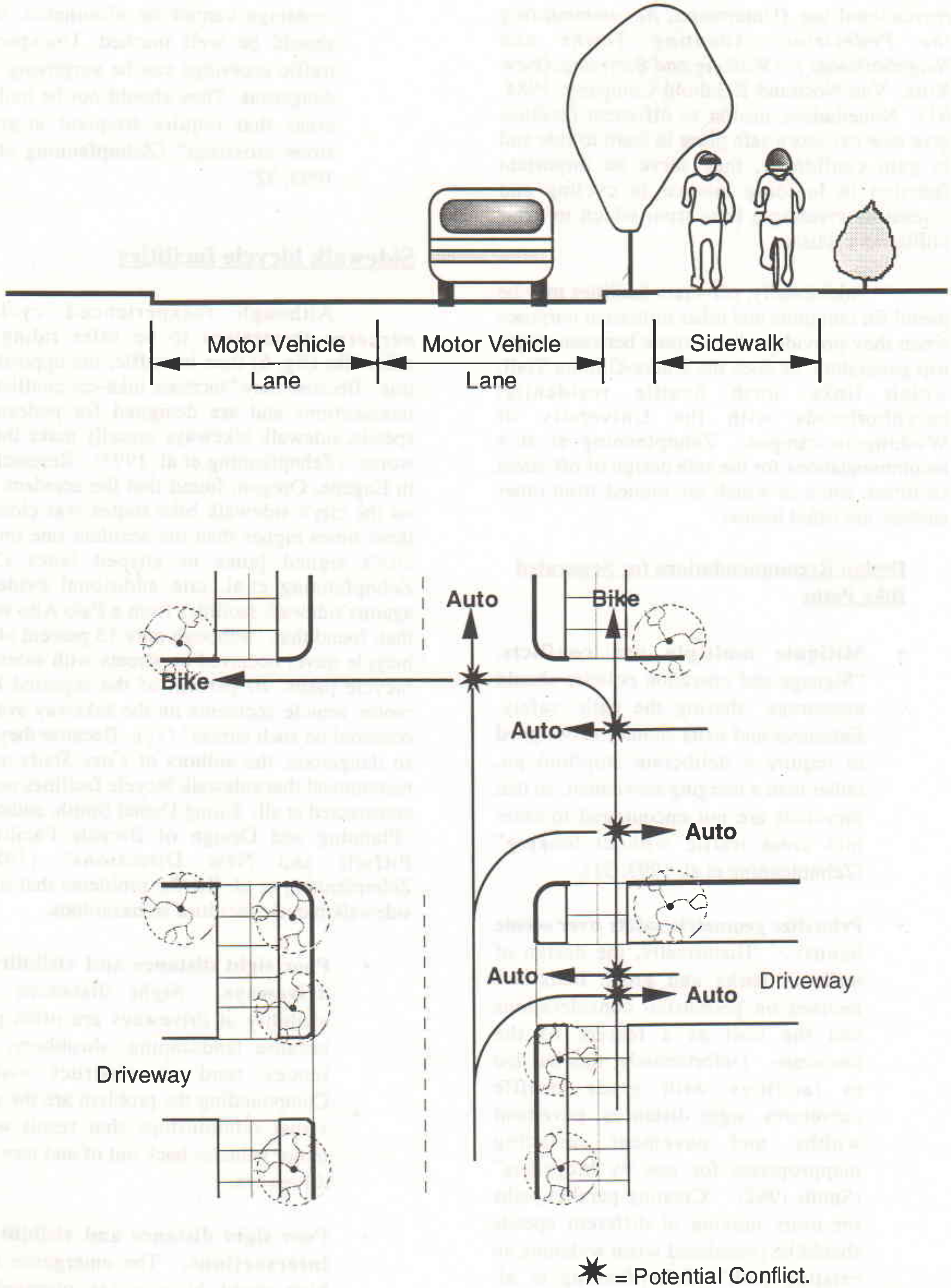



**Figure 6. Sidewalk bicycle facility**

- **Tendency to use sidewalk bikeways bi-directionally, despite signs and warnings to the contrary.** Bi-directional operations compound the sight distance-visual relationship problems at driveways and intersections noted above.

- **Problems associated with shared pedestrian and cycling use.** Pedestrians' movements are unpredictable, they may veer or change direction suddenly. This tendency leads to the potential for accidents with faster moving cyclists, particularly when the pedestrians are blind or elderly.

In summarizing the discussion of sidewalk bicycle facilities, Zehnpfenning et al. again cite the Palo Alto study, this time noting that sidewalk bicycle facilities actually "aggravated and compounded conflicts among drivers, cyclists, and pedestrians" (Final Report on the Palo Alto Bikeway System 1974, 11; cited in Zehnpfenning et al. 1993, 32). Based on this evidence, transportation planners in Palo Alto concluded that "the accident rate reduction along streets with bicycle lanes tends to support the need for more bicycle lanes and fewer exclusive bicycle paths and shared sidewalk bicycle paths in urban areas."

## On-Street Facilities

Although off-street bike paths such as the Burke-Gilman Trail in some senses represent the ideal bicycling environment, it would not be realistic to rely on the construction of a grid of off-street facilities as the primary means of promoting utilitarian cycling. Land availability and cost are two of the chief concerns. Insofar as a major portion of utilitarian cycling will take place in population centers, areas characterized by extensive development, it would be extremely costly (if even possible) to purchase the rights-of-way to build or extend off-street, separated bike paths. In any case, the scattered corridors that may be economically feasible could only do so much to induce higher levels of utilitarian cycling. Zehnpfenning et al. conclude that what is really needed is a comprehensive network of safely designed bicycle facilities that link major trip generators directly.

> Although surveys indicate a desire for off-street bike paths, corridors separated from auto traffic, such as a riverfront, are often not available in established cities. Devoting resources to creating a few major paths, making existing streets exclusive bike pathways, or building grade-separated bike and pedestrian facilities can't provide the geographic coverage to satisfy the needs of the community (1993).

Zehnpfenning et al. go on to note that the upshot of this cost issue is an emphasis on roadway improvements that allow cyclists to use *existing* roadways more safely. "The focus on bikeways has shifted since the early 1970s, from physically separating bikes from motor vehicles by constructing bike paths, to the current trend toward roadway bikeways" (AASHTO Quarterly 1990; cited in Zehnpfenning et al. 1993, 33). Insofar as on-street facilities are financially feasible in most cases, we will consider their design features in some detail.

### Design Considerations for On-Street Facilities

There are basically three types of on-street (or roadway) bicycle facilities:

- Striped bike lanes
- Unstriped, wide curb lanes that can accommodate one motor vehicle and one bicycle side-by-side
- Hybrid lanes, which combine elements of striped bike lanes with elements of wide curb lanes

### Striped Bike Lanes.

Striped bike lanes are controversial. Some experienced cyclists contend that striped bike lanes are actually unsafe for cyclists, and that their existence reflects a pervasive anti-bicycling bias among mainstream transportation policy makers.

> The second special law that discriminates against cyclists is the mandatory-bike-lane law, which restricts cyclists to bike lanes where they are provided. Again, there is the

contrast between the publicized motive of "bike safety" and the real motive, which is to preserve the normal traffic lanes for motorists. The bike lane stripe simply keeps motorists to its left and cyclists to its right, which is appropriate when the motorist is overtaking the cyclist or is turning left, but is inappropriate when the cyclist is overtaking the motorist or is turning left, or when the motorist is turning right (Forester 1993, 283).

The federal study (USDOT 1994) acknowledges this controversy and includes in its discussion, both the advantages and disadvantages of striped bicycle lanes. But before moving on to this comparison, we will turn to what Zehnpfenning et al. consider to be two overriding issues in the design of striped bike lanes: (1) adequate lane width and (2) attention to intersections.

**Adequate lane width.** The need for sufficient lateral space is critical (Zehnpfenning et al. 1993, 43). When cyclists are not compelled to hug the curb because of a narrow roadway, visibility is improved all around (i.e., motorists see cyclists earlier and more clearly, and vice versa). Moreover, adequate lane width allows cyclists more space in which to maneuver and to prepare for turning movements at intersections. It also gives cyclists enough leeway to steer clear of motorists opening parked car doors directly into the cyclist's path. Being forced too far to the right by a lack of space is also dangerous insofar as it puts cyclists into the midst of right-turning motorists and too close to vehicles that are entering traffic from side streets. Adequate lane space also gives motorists enough space to safely overtake cyclists midblock, an important consideration given speed differentials between cars and bicycles.

To mitigate the danger of riding too close to the right side of the road, Forester offers bicyclists the following advice, "On wide roads, ride just outside the actual traffic lane—not along the curb, but about three feet from the cars. On narrow roads, ride generally just inside the traffic lanes, allowing room for a car to pass you by going partly over the far lane line" (294). One disadvantage of striped bike lanes is that they make it difficult for cyclists to move freely to Forester's recommended roadway positions.

**How wide is wide enough?** Citing John Williams, Zehnpfenning et al. footnote the following specification, "Fifteen feet makes more sense for a wide curb width. Reason: in the future, a 15-foot wide curb lane can be restriped for an 11-foot motorized lane with a 4-foot bicycle lane" (34, John Williams, ed., "Reviewing the '81 AASHTO Guide," Bicycle Forum, 26 (November 1990) 8.) Accordingly, Zehnpfenning et al. recommend that the federal government urge public works departments at the state and local levels to "adopt standards requiring all non-high-speed arterial roads to have adequate space for bike operations. These standards should apply when any road is restriped, modified, or reconstructed" (Zehnpfenning et al. 1994). Moreover, they stress that "It is extremely important that the foregoing standards be an integral part of all accepted national engineering manuals such as the *AASHTO Guide*, the *Manual of Uniform Traffic Control Devices*, the *Highway Capacity Manual*, and *CalTrans Standards*" (34).

**Attention to intersections.** Citing a *Transportation Research Circular*, Zehnpfenning et al. note that attention to intersections is critical because "Previous studies have found that the majority of serious bike accidents occur at or near intersections" (1993). This contention is also supported by Forester (1993). Poorly designed bike lanes make intersections dangerous for cyclists because the painted lane may have the effect of trapping cyclists in dangerous locations with poor visibility. For example, cyclists who remain in a right-side bike lane when they need to turn left may be struck by a car moving straight through the intersection as the cyclist turns left across its path. As another example, curb-hugging cyclists proceeding straight through an intersection may be struck by right-turning automobiles. Because of these and other hazards, Forester suggests that left-turning cyclists position themselves on the left near the centerline; that right-turning cyclists position themselves on the right near the curb; and that straight-moving cyclists position themselves between these two locations.

Because cyclists are safer if they are correctly positioned at intersections, and because painted lanes tend to trap cyclists in inappropriate locations, Zehnpfenning et al. recommend that striping be deleted at the approaches to intersections, a feature that would allow cyclists to move freely into roadway locations where they are most visible, and less likely to be struck by motor vehicles.

Zehnpfenning et al. enumerate the advantages and disadvantages of striped bike lanes, most of which are paraphrased below (1993, 36-37).

**Advantages of Striped Bicycle Lanes**

- Striped bicycle lanes provide a place to cycle outside of high-speed, high-volume vehicle traffic, except at intersections
- Survey results indicate that people want more "bicycle lanes," which suggests that more people would ride if such lanes were provided
- Inexperienced riders seem to feel more secure when they are separated from traffic by a painted line
- Painted lanes may help legitimize the presence of bikes on the road, provided that cyclists use these lanes properly
- Painted lanes may alert motorists to the presence of cyclists
- Bike lane installation generally ensures adequate lateral space for bikes (which is not the case on many bike routes)
- The existence of painted lanes may help to ensure that the space is not be usurped by future traffic lanes
- Lane markings guide riders around curves in the road
- Painted lanes may make drivers feel more comfortable about passing slower-moving cyclists
- Painted lanes may reduce wrong-way riding if they are also marked with directional arrows

**Disadvantages of Striped Bike Lanes**

- Painted stripes encourage cyclists to ride in an unsafe locations at intersections
- Lanes may give cyclists a false sense of security
- Lanes may restrict cyclists to the right curb, where they are less visible to motorists
- Motorists may regard cyclists who move to the inside lane (to safely negotiate left turns) as "outlaws"
- Lane markings are subject to wear by auto tires because of their locations
- Some lane marking materials become slick when wet

## Wide Curb Lanes

Wide curb lanes, which have basically the same dimensions as striped lanes, except that they are not marked in any way, may be a good alternative to striped bike lanes. The chief distinction between wide curb lanes and striped bicycle lanes is that wide curb lanes contain no markings that carve out separate "turf" for cyclists and motorists. Insofar as cyclists are not "painted into" dangerous roadway positions at intersections, wide curb lanes make it easier for cyclists to move freely into safe roadway positions. Wide curb lanes are generally about 15 feet across, wide enough to accommodate a motor vehicle and a bicyclist side-by-side, but not wide enough to accommodate two motor vehicles.

A disadvantage of wide curb lanes is that they lack bicycle lanes' striped markings. This may be a problem insofar as some feel that lane markings legitimize cyclists' use of the roadway, and that additionally, these markings alert motorists to cyclists' presence. To address this concern, Zehnpfenning et al. suggest a third alternative, hybrid bike lanes, which combine aspects of striped lanes (namely bicycle markings, but not stripes) and wide curb lanes (which allow cyclists to move freely into safe roadway positions at intersections).

## Hybrid Bike Lanes

Hybrid bike lanes have the same cross section as wide curb lanes (approximately 15 feet wide), with the addition of regularly spaced bike symbols and directional arrows painted in the center of the curb lane. No stripe designates spatial boundaries for either bicycles or autos. Moreover, even the symbols and arrows disappear at the approach to intersections, a feature intended to let cyclists move freely into safe positions without undue fear of confusing or antagonizing motorists. Zehnpfenning et al. enumerate the advantages and disadvantages of hybrid bike lanes, most of which are paraphrased below (1993, 38).

**Advantages of Hybrid Bike Lanes**

- Provide space for bikes to ride out of high-speed, high-volume traffic, except at intersections
- Markings legitimize the presence of bikes on the road
- Markings alert motorists to the presence of cyclists
- Markings designate a cycling area where new cyclists may feel more secure
- Hybrid bike lanes are generally wide enough for bikes (which is not the case on many existing bike routes)
- Hybrid bike lanes help ensure that the space will not be usurped by a future traffic lane
- Markings help guide riders around curves
- Directional arrows reduce wrong-way driving
- Because of their location, markings are less likely to be worn by auto tires
- Cyclists who move into a safe position at intersections are less likely to be perceived as "outlaws" by motorists because intersections of hybrid bike lanes are devoid of bicycle-specific spaces

**Disadvantages of Hybrid Bike Lanes**

- Hybrid bike lanes may create a sense that on-street biking is safer than it actually is, and as such, lead to a lack of caution
- They may encourage the "sweeping" motion of cars, which pushes debris into the bike lane

## Traffic Engineering

Thus far, the discussion of bicycle facility design has been restricted to various roadway configurations; however, elements of traffic engineering may be fine-tuned to make signalization respond to cyclists' needs, and by extension, to make cycling safer and more attractive. Moffat (1992) analyzed bicycle crashes with motor vehicles and found that two of the commonest contributions by cyclists to these accidents were (1) riding through red lights and (2) failing to stop at stop signs. Many cyclists proceed through red lights because the loop detectors embedded in the pavement, which control the intersection signals, are not activated by bicyclists.

Forester explains the evolution of loop detectors,

> In the 1930s, the vehicle detectors were switches set in slots in the roadway, which responded to the weight of cars, motorcycles, carts, bicycles, and pedestrians (if they stepped on the switch). However, these switches frequently needed expensive repairs. In the early 1950s, electronic metal detectors (invented to detect buried land mines in World War II) were adapted to serve as vehicle detectors. A loop of wire buried in the road surface activated the control circuit whenever a metal object was above the loop. Because these loops needed far fewer repairs than switches, traffic engineers and highway departments rapidly adopted them. However, there was one catch. Because activating a loop required more metal than a bicycle has, it wouldn't detect a bicycle...While some traffic engineers now install bicycle-responsive detectors, the standard of the Institute of Transportation Engineers still doesn't require the detection of bicycles (Forester 1993, 316).

## Bicycle-activated loop detectors

Zehnpfenning et al. (1993) and Forester (1993) are of one mind when it comes to adjusting signalization at intersections to respond to cyclists. Forester (1993) contends that loop detectors embedded in the roadway are too rarely equipped to register the presence of a bicyclists. Consequently, cyclists may have to wait for an extended period at an empty intersection. This tendency tempts bicyclists into the dangerous habit of disregarding red lights, a habit that Forester encourages. He argues that bicyclists should disobey traffic signals that do not detect bicyclists because such signals should be considered inoperative. In fact, Forester advocates that cyclists disobey such signals, arguing that signals that do not detect cyclists are inoperative. Insofar as motorists are not obliged to obey inoperative signals, "your action is not unlawful; you have no duty to obey inoperative traffic signals, and a traffic signal that will not give a green in response to a lawful movement is inoperative" (315). It may be an understatement to characterize Forester's position vis-à-vis the transportation establishment as adversarial. [6]

In any case, Forester goes on to explain the ease with which traffic engineers can alter loop detectors to make them register the presence of cyclists. "The loop needs to be relaid as a figure-eight instead of a plain rectangle, and the amplifier must be adjusted to match it" (317). Zehnpfenning et al. concur with Forester on this point, and they include the implementation of bike-activated traffic signals in their final recommendations: "Encourage safe and responsible bicycling through provisions to allow riders to activate the green phase of traffic signals. Without this feature, bicyclists tend to disregard traffic signals because they regard the system as unresponsive to their needs" (Zehnpfenning et al. 1993, 93).

## Signal timing

Another issue in traffic engineering at intersections is signal timing. One problem for cyclists is that lights switch from red to green too quickly, which does not give slower-moving cyclists enough time to clear the intersection. According to Forester,

> The fifth most frequent type of car-bike collision is the cyclist being hit as the signal changes, and this is the second most frequent type for adults who have learned how to avoid the more simple ones...Impatient drivers who start suddenly, and drivers who hadn't yet stopped when they saw their signal change to green, enter the intersection while slower drivers from the other direction are still in it. Collisions result (315).

According to both Zehnpfenning et al. and Forester, the solution to this problem is straightforward: provide an all-red phase after green and yellow in the traffic light sequence. This alteration, too, is among Zehnpfenning et al.'s final recommendations (1993).

## Wrong-way Signage

The second most common cause of bicycle-motor vehicle crashes is wrong-way cycling, which accounts for 17 percent of the total (Forester 1993). Forester describes the danger:

> You could probably ride safely enough on the left of a straight road without intersections—the oncoming drivers would see you in time. The danger is at intersections. Drivers, other cyclists included, look left first, then right, then left again as they start to move. If you are coming the wrong way, they will hit you before they see you (293).

Because wrong-way riding is both common and very dangerous, Zehnpfenning et al. advocate marking bicycle lanes and wide curb lanes with arrows to indicate the direction of travel, which should correspond to the flow of motor vehicles. Citing D. Smith (1982), Zehnpfenning et al. echo Forester's admonitions about the danger of wrong-way riding.

---

[6] For example, the following quote conveys the tone that underlies his message, "The highway establishment has hardly been hurt by our opposition. It will keep steamrolling over us without feeling any pain. They have never respected our rights and see no reason to start doing so now" (570).

Riding against traffic has been identified as a significant causal factor in midblock and intersection bike-motor vehicle accidents. And provision of properly marked bike lanes has been demonstrated to significant effect in decreasing wrong-way riding. In Santa Clara County, California, before and after observations on three bike lane facilities showed a 21 percent decrease (after marking), (cited in Zehnpfenning et al. 1993, 45).

## Summary Recommendations from Case Studies 4 and 6

Both Goldsmith, author of *Case Study no. 1*, and Zehnpfenning et al., authors of *Case Study no. 4*, offer summary recommendations for removing barriers to utilitarian cycling. Those recommendations most relevant to this report, the focus of which is safety, are consolidated into the following subheadings: (1) Facility Design and (2) Access and Linkage. Access and linkage are related to safety because bicyclists need not use just isolated corridors of safe bicycling facilities, but comprehensive networks that allow them to make their entire trips safe, or relatively safe, conditions. Another critical aspect involves education and enforcement. Programs in cities such as Ann Arbor, Boulder, and Seattle are described in Appendix A.

### Facility Design

- **Relatively safe facilities.** "Only a few types of facility enhancements have actually been tested to measure their success in increasing ridership." From this research, a reasonable correlation has been found between increased usage and classes of facilities that allow bicyclists a space to ride out of the constant flow of fast or heavy automobile traffic. This finding provides a broad general list of acceptable options from which to choose...

  Completely separated off-street bike paths

  Safe, well designed, on-street bike lanes

  Wide curb lanes and adequate roadway shoulders

  Low-speed, low-volume streets

- **Striped bicycle lanes.** "Exercise care in designing bicycle lane configuration so that they do not encourage unsafe riding near intersections. Use lane plans that encourage bicyclists to be seen and their intentions understood by other vehicles at intersections" (Zehnpfenning et al. 1994, 92).

- **Adequate width for bicycles.** "Cities should adopt a policy that requires traffic lanes adjacent to the curb to be designed to provide adequate width for motor vehicles and bicycles to pass abreast of each other. Off-street bicycle facilities require adequate pavement width to accommodate the variety of users or a parallel path to separate high and low speed users and to discourage very high speeds. Proper signage, education, and enforcement are important in persuading bicyclists to share the path" Zehnpfenning et al. 1994, 92).

- **Off-road bike paths**. "Opportunities for new or extended bike paths should be pursued because of their attractiveness to recreational and inexperienced riders. Off-street bicycle paths are regarded by inexperienced bicyclists as the most preferred facilities because they are separate from motor vehicle traffic. Paths are also well-used by experienced riders, especially if they are located for convenient commuting" (Zehnpfenning et al. 1994, 92).

### Access and Linkage

- **Linkage**. "Focus should be placed on creating a linked network of bicycle facilities so that access to all areas of a city are enhanced. If a city wide system is infeasible, then facilities could be concentrate in areas or along corridors where the young live and move..."(Goldsmith 1994, 81).

- **Focus on major trip generators.** "Bicycling should be promoted and requisite facilities expanded or enhanced in those places where high levels of bicycling are likely. Areas with high concentrations of people under 35 (such as university communities), short travel distances between key trip generators (five miles or less for the work commute; two miles or less for errands), and space for on-road facilities should receive top priority "(Goldsmith 1994, 81).

- **Work toward a comprehensive network.** "The key facility improvement to increase bicycling is identification and attainment of a comprehensive network of convenient, regularly-spaced, on- and off-street facilities providing extensive coverage. This can be realized through the adoption of a firm policy prompting new or reconstructed streets to be configured to include wide curb lanes or safely designed bike lanes, and through the construction of completely separated bike paths to serve major destinations, where feasible" (Zehnpfenning et al. 1994, 90).

  "Fill connection gaps and link existing bicycle facilities (Zehnpfenning et al. 1994, 91):

  Provide safer crossings and intersections
  Widen narrow sections of on-street bicycle routes
  Add strategic bridges and underpasses

  "Make linkages across natural and man-made barriers to connect major destinations as directly as possible" (Zehnpfenning et al. 1994, 91).

  "Provide bicycle facility alignments that shorten travel time compared to automobile routes" (Zehnpfenning et al. 1994, 91).

  "Ensure that bicycle-friendly roads are frequent and direct to maximize the number of people within easy bicycling distance of jobs, shopping, school, recreation, and entertainment" (Zehnpfenning et al. 1994, 91).

# 3. Funding Bicycle Projects

In the first chapter of this report, safety concerns were discussed as a deterrent to higher levels of bicycling. This was followed by an exploration of the technical characteristics of relatively safe bicycle facilities. Insofar as it is expensive to construct, improve, and maintain such facilities, how to fund these projects is an issue. In any case, it is an opportune time to consider ways to enhance bicycle facilities because of increased interest in transportation efficiency and environmental quality, both of which are reflected in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).

One of the case studies that comprises the *National Bicycling and Walking Study* (USDOT 1994) lists, and to some extent analyzes, sources of actual and potential funding for bicycle facilities. Prepared by the Bicycle Federation of America (BFA), *Case Study no. 5: An Analysis of Current Funding Mechanisms for Bicycle and Pedestrian Programs at the Federal, State, and Local Level*, points out that bicycle facilities may be funded at all levels of government, and that the private sector may also be involved: through developer dedications, mitigation measures, in-kind donations, and gifts. In fact, a distinctive feature of bicycle projects, as opposed to interstate construction, for example, is that numerous funding sources are often combined, bringing together resources from all levels of government as well as the private sector.

However, as this case study also indicates, funding for bicycle projects is not well understood. The BFA case study thus begins to address this gap by listing the various funding sources. As such, it is recommended reading for anyone involved in funding the construction, improvement, or implementation of bicycle projects. This chapter does not attempt to duplicate or even overview this case study. Rather, its purpose is to supplement the case study by providing background information on ISTEA and by presenting new data on selected MPOs' expenditure of ISTEA allocations for bicycle projects.

## ISTEA

As noted in the Introduction, the potential for obtaining federal funding for bicycle projects has never been greater, thanks to provisions of ISTEA, which authorizes the allocation of $155 billion between FY 1992 and 1997 for surface transportation projects. ISTEA may be thought of as a large bundle of legal provisions and associated funding mechanisms that collectively sets policy parameters for a large portion of the U.S. Department of Transportation's overall activities. ISTEA is divided into eight titles, under each of which is organized a set of programs or provisions.

Title I—Surface Transportation

Title II—Highway Safety

Title III—Federal Transit Act Amendments of 1991

Title IV—Motor Carrier Act of 1991

Title V—Intermodal Transportation

Title VI—Research

Title VII—Air Transportation

Title VIII—Extension of Highway-Related Taxes and Highway Trust Fund

**Flexibility**. ISTEA represents a departure from "business as usual" in several respects. First, the legislation gives state departments of transportation and metropolitan planning organizations considerably more latitude than they have had in the past to distribute federal monies among project categories. The implications of this flexibility extend to bicycle facilities, as this example from the *ISTEA Handbook* (Washington Transportation Policy Institute n.d.), illustrates, "bridge funds transferred to the Surface Transportation Program could be used for bicycle and pedestrian projects." This new flexibility is considered to be one the most significant aspects of the legislation. In an introduction to a brochure summarizing ISTEA, former Washington State Secretary of Transportation, Duane Berentson, asserted,

> The ISTEA of 1991 is a significant departure from previous transportation programs and will require careful reading and interpretation. The increased "flexibility" provided through the Act encourages creative solutions and provides unique opportunities for meeting our transportation needs (USDOT 1992, i).

**Intermodalism**. Another aspect in which ISTEA departs from the past is in its emphasis on intermodalism, which refers to the ease and efficiency of connections among various transportation modes (e.g., transit and rail, automobiles and air, bicycles and transit, etc.). Improving coordination among modes is assumed to make the overall transportation infrastructure more efficient. Although large amounts of funding are not authorized under Title V, ISTEA plants the seeds for future programs by establishing an Office of Intermodalism within the Office of the Secretary of Transportation. Title V also commissioned a study to look into issues associated with intermodalism, including the current status of intermodal transport, intermodal impacts on the public works infrastructure, and legal impediments to efficient intermodal transportation (Intermodal Surface Transportation Efficiency Act of 1991, Public Law 102-240). This emphasis on intermodalism may have repercussions for bicycle travel insofar as projects that link bikeways with on-street facilities, bicycles with transit, or any other combination, may enhance the intermodal infrastructure.

Not all titles of ISTEA have implications for bicycle facilities. For example, the program that deals with the interstate system (under Title I) is not relevant to bicycle travel. Figure 7 depicts the funding sources relevant to bicycles as listed in the BFA case study. The original chart categorizes funding by the level of government from which they may be obtained (federal, state, or local).

Figure 8 is intended to give the reader a clearer grasp of the scope of ISTEA, as well the locations within the Act of the various bicycle-funding programs. This original graphic is based on several sources: the BFA case study (1993), the text of ISTEA (Public Law 102-240), and a summary guide to ISTEA prepared for Washington state by the USDOT (1992).

**Title I—Surface Transportation**

Title I—Surface Transportation is most relevant to bicycle projects. Insofar as Title I encompasses the construction and maintenance of the nation's highways, it also represents by far the largest source of ISTEA allocations. Of the $155 billion authorized under ISTEA, $122 billion, fully 78 percent, falls under Title I. The General Surface Transportation Program (confusingly a subcategory of Title I, also called Surface Transportation), is the most relevant program for bicycle facilities because of provisions for Transportation Enhancement Activities.

**Transportation Enhancement Activities**. This provision of the general surface transportation program under ISTEA stipulates that ten percent of funds from the general STP category be spent for transportation enhancement activities (TEAs). While 80 percent of the funds may be used for a broad range of projects, such as roadway construction, capital costs for transit, and capital and operating costs for traffic management and control, ten types of projects are eligible for TEA monies, two of which refer to bicycle projects specifically (WTIP n.d., 16):

**Pedestrian and bicycle facilities**
Acquisitions of scenic easement and scenic or historic sites
Scenic or historic highway programs
Landscaping or other scenic beautification
Historic preservation

Rehabilitation and operation of historic transportation buildings
Structures or facilities including historic railroad facilities and canals
**Preservation of abandoned railroad corridors, including the use thereof for pedestrian or bicycle trails**
Control and removal of outdoor advertising
Archaeological planning and research
Mitigation of water pollution due to highway runoff

The **Congestion Mitigation and Air Quality Management Program (CMAQ)** is another important, well funded Title I program. Projects eligible for CMAQ funding may involve a range of activities that reduce motor vehicle-related air pollution. As such, eligible projects include,

> ...transit and transit-related projects and programs and transportation control measures established by the Clean Air Act, for example, the development of new transportation demand management programs and pedestrian and bicycle facilities (WTPI n.d. 26).

Citing a Federal Highway Administration document, the authors of *Case Study no. 5* point out that there are basically five areas of CMAQ eligibility: (1) transportation activities in an approved State Implementation Plan (SIP) developed under the Clean Air Act; (2) programs or policies that limit some portion of the roadway or metropolitan area to nonmotorized travel; (3) provisions for secure bicycle parking, and bike lanes in public and private facilities; (4) programs for new construction and reconstruction of facilities solely for use by nonmotorized modes; and, (5) "construction of bicycle and pedestrian facilities, non-construction projects related to safe bicycle use and State bicycle/pedestrian coordinator positions" (BFA 1992, 12).

## How MPOs Spend Money For Bicycle Projects and Programs

**Appendix B**. This multi-page table indicates how selected MPOs around the country are actually allocating portions of their ISTEA monies to fund bicycle projects. These tables are based on original Innovations Unit research that extracted funding data directly from 1993 Transportation Improvement Programs from MPOs with a known interest in bicycle travel. The value of these tables lies in the fact that little is yet known about ISTEA's actual outcome in terms of funding bicycle projects. Insofar as the Act was passed relatively recently (December 1991), few data have yet been assembled to indicate what percentages of their ISTEA resources MPOs are dedicating to bicycle projects, how much money those percentages represent, and a host of other financial issues. While the information contained in these tables begins to address this data gap, more research into the precise means by which agencies at all levels of government fund their bicycle projects (e.g., detailed information about costs, funding combinations, and the proportional splits thereof), has yet to be assembled and analyzed. This type of information would be valuable insofar as it would provide those interested in enhancing bicycle travel with information they could use to develop effective funding strategies.

**Appendix C** lists innovative programs by state and local governments around the country to fund bicycle improvements.

## Figure 7. Funding Sources for Bicycle Projects and Facilities

### FEDERAL

**U.S. Department of Transportation**
- ISTEA

**U.S. Department of the Interior**
- Land and Water Conservation Fund
- Rivers, Trails and Conservation Assistance Program

**Congressional Appropriations** (e.g., $3 million for the H Connector Trail from Greene County, Ohio, to Dayton)

**Miscellaneous**
- Centers for Disease Control
- U.S. Environmental Protection Agency

### STATE

**State Department of Transportation Construction and Maintenance Funds**

**State Legislative Mandate**
- Minimum allocation of funds
- Set-aside funds—bicycle accounts
- Tax receipts (e.g., auto title, transfers, sales taxes) of special trail funds
- Bicycle line items in budget
- Integration of bicycle-friendly improvements into State DOT's routine roadway design

**Citizen Initiatives** (e.g., California's propositions 108, 111, and 116)

**Governor's Energy Office** (Oil Overcharge Funds)

**Other State Agencies**
- State Departments of:
  - Tourism, Economic Development
  - Geology
  - Public Safety
  - Health
- State Division of Parks and Recreation

**Coastal Conservancy Funds (California)**

**Lottery Receipts**

### LOCAL

**Local Transportation Department Funds**
- Minimum allocation of funds
- Special projects

**Sales Taxes**

**Open Space Bonds**

**Mitigation Measures**

**Developer Dedications**

**Restoration** (e.g., MCI improved sections of the Burke-Gilman Trail after the cable company dug up the right-of-way to lay cable)

**Public Agency Land Donations and Funds** (e.g., The Port of Seattle, and Metro, in conjunction with the Drwamish Trail)

**Motor Vehicle Registration Fees**

**Street Utility Taxes**

**Parks and Recreation Departments**

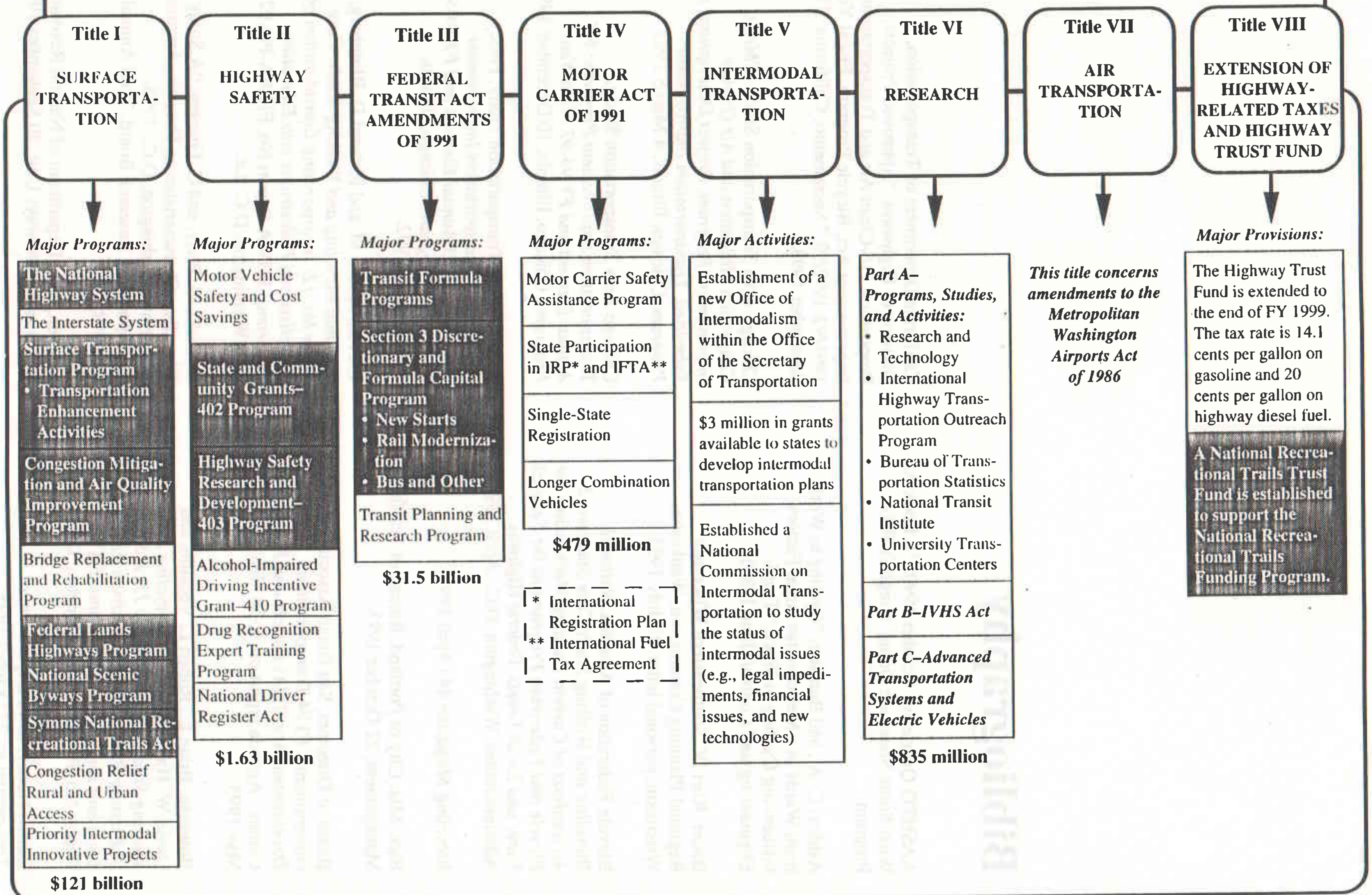
**Donations**

**Fundraising Events**

**Bicycle Registration**

*Original table created by Innovations Unit staff, based on data from BFA (1993).*

**Figure 8. The Intermodal Surface Transporation Efficiency Act of 1991**




KEY: These programs are actual or potential sources of funding for bicycling facilities

*Table by Innovations Unit staff, based on data from BFA 1993; ISTEA (Public Law 102-240); USDOT 1992.*

# Bibliography


AASHTO Quarterly, October 1990, "A Look At What Some States are Doing: Oregon's Bike Program."

Ashley, C. A., and Banister. "Cycling to Work from Wards in a Metropolitan Area: Factors Influencing Cycling to Work." *Traffic Engineering and Control* (June 1989).

Bauer, Kurt W. Southeastern Wisconsin Regional Planning Commission, Waukesha, Wisconsin, personal letter, 13 July 1993.

Bicycle Federation of America. *National Bicycling and Walking Study Case Study no. 5 An Analysis of Current Funding Mechanisms for Bicycle and Pedestrian Programs at the Federal, State, and Local Levels.* Federal Highway Administration, Washington, D.C., April 1992.

*Bicycling Magazine* 44 (April 1991).

Birk, Mia, City of Portland, Bureau of Traffic Management, 22 October 1993.

Board of Directors, San Diego Association of Governments. *FY94 Transportation Development Act (TDA) Bicycle and Pedestrian Claims.* Agenda report no. R-56. San Diego, 28 May 1993.

Bowman, Brian L., Robert L. Vecellio, and David W. Haynes, *National Bicycling and Walking Study, Case Study No. 13: A Synthesis of Existing Bicyclist and Pedestrian Related Laws and Enforcement Programs*, FHWA Report No. PD-93-018, Washington, D.C., 1993.

Burns, Nancy, Iowa Department of Transportation, 22 October 1993.

California Department of Transportation, Division of Highways. "Approved Projects, Proposition 116-Clean Air and Transportation Improvement Act, Bicycle Program, Fiscal Year 1991/92-1992/93." Sacramento, California, 27 September 1993.

Chicago Area Transportation Study. *CMAQ: Congestion Mitigation and Air Quality Improvement Program, Project Descriptions as Submitted, Transportation Improvement Program.* Chicago, Illinois, 4 March 1993.

Chicago Area Transportation Study. *Transportation Improvement Program: FY Annual Element and FY 94-97 Multi-Year Program* , Chicago, Illinois, 10 December 1992.

Chicago Area Transportation Study, Policy Committee. *Transportation Improvement Program, FY 93 Annual Element and FY 94-97 Multi-Year Program*, Chicago, Illinois, 10 December 1992.

Cleven, Arlene M. and Richard D. Blomberg, *National Bicycling and Walking Study, Case Study No. 12: Incorporating Consideration of Bicyclists and Pedestrians into Education Programs*, FHWA Report No. FHWA-PD-92-036, Washington, D.C. n.d.

Cynecki, G. Perry, and G. Frangos. "A Study of Bicyclists Characteristics in Phoenix, Arizona" (Preprint), Washington, D.C., 1993, Transportation Research Board, 72nd Annual Meeting.

Danger, Tom, Department of Natural Resources, Trails and Waterways Unit, 20 September 1993.

Denver Regional Council of Governments. "1992-1998 Transportation Improvement Program: Selection of Projects," 10 September 1992. pp. 1-20. Unpublished memo.

Denver Regional Council of Governments. *1993-1995 Transportation Improvement Program,* Denver, Colorado, 20 January 1993.

Denver Regional Council of Governments. *Project Evaluation and Priority Determination.* Transportation Improvement Program: Procedural Manual. August 1992.

Department of Public Works, Roads Division, Transportation Planning Section, King County. *King County Non-motorized Transportation Plan, Executive Proposal,* Seattle, Washington, March 1993.

Everett, Michael, and John Spencer. "Empirical Evidence on Determinants of Mass Bicycle Commuting in the United States: A Cross-Community Analysis." *Transportation Research Record* 912, Washington, D.C. (1983):28-37.

*Final Report on the Palo Alto Bikeway System,* Palo Alto, California, 1974.

Forester, John. *Effective Cycling.* Sixth ed. Boston: MIT Press, 1993.

Garreau, Joel. *Edge City: Life on the New Frontier.* New York: Doubleday, 1991.

Gebbie, Kristine M. *Strategies for Prevention, Bicycle Injuries in Washington State,* Washington State Department of Health, Washington State Injury Prevention Program, Olympia, Washington, November 1992.

Genesee Transportation Council. *Transportation Improvement Program, 1993-1998,* Genesee Transportation Council, Rochester, New York, 9 March 1993.

Goldsmith, Stuart A. *National Bicycling and Walking Study Case Study no. 1 Reasons Why Bicycling and Walking Are and Are Not Being Used More Extensively as Travel Modes,* Federal Highway Administration, Washington, D.C., 1994.

Hillsborough County Metropolitan Planning Organization. *Transportation Improvement Program, Project Evaluation and Selection Process,* Tampa, Florida, October 1992.

Hillsborough County Metropolitan Planning Organization. *Transportation Improvement Program for Fiscal Years 1993/94-1997/98,* Tampa, Florida, 4 May 1993.

Hullberg, Ron, Illinois Department of Conservation, 26 October 1993.

Jackson, Kenneth T. *Crabgrass Frontier: The Suburbanization of the United States.* New York: Oxford University Press, 1985.

John Hohl. *Directory of Metropolitan Planning Organizations and State Transportation Agencies,* U.S. Department of Transportation, Washington, D.C., January 1992.

Johnson, Anna, University of Colorado, telephone interview with author, 25 May 1992.

Kahneman, D., P. Slovic, and A. Tversky. *Judgment Under Uncertainty: Heuristics and Biases.* New York, New York: Cambridge University Press, 1982.

Keller, Mary, Maryland State Highway Administration, Bicycle and Pedestrian Program, telephone interview with author, 19 September 1993.

Lagerwey, Peter, City of Seattle Engineering Department, telephone interview with author, 17 November 1993.

Lagerwey, Peter A., and Thomas S. Pendelton. *Designing and Implementing a Bicycle Patrol: A Report on the 1980 Ann Arbor Bicycle Patrol for the Michigan Energy Administration,* Bicycle program, Transportation Department, City of Ann Arbor, Michigan, June 1981.

Legislative Committee on Minnesota Resources. *Enhancing and Protecting Minnesota Resources.* Number 6 (June 1993).

Legislative Commission on Minnesota Resources. *First Biennial Revision, Six-Year Strategic Plan for Guiding Recommended Expenditures from Minnesota Future Resources Fund, Minnesota Environment and Natural Resources Trust Fund, and Oil Overcharge Money.* (This plan incorporates the revision to the July 1990–July 1996 Strategic Plan for the Trust Fund and is based on a draft submitted by the Citizen Advisory Committee as advisory to the Legislative Commission on Minnesota Resources.) St. Paul, Minnesota, December 1991.

Legislative Commission on Minnesota Resources (LCMR). *Projects: July 1, 1991 - June 30, 1993. Laws 1991 Chapter 254 Including Projects From: MN Future Resources Fund (MFRF), Oil Overcharge Fund, Environment and Natural Resources Trust Fund, M.S. 1991 Chapter 254, Sec. 14, July 1, 1991-June 30, 1993.* St. Paul, Minnesota.

Lott, D., T. Tardiff, and D. Lott. "Bicycle Transportation for Downtown Work Trips: A Case Study in Davis, California." *Transportation Research Record 629* .

Mannering, Fred L., and Lawrence L. Grodsky. "Statistical Analysis of Motorcyclists' Perceived Accident Risk," 7 December 1993.

Maricopa Association of Governments. *Transportation Improvement Program of Maricopa County*, 1992.

McCormick, Ed. *1991 Transportation Costs*, Florida Department of Transportation, 1 July 1991.

Martin, Scott. "Ten Best Cities for Bicycling," *Bicycling* magazine (April 1990).

Metropolitan Council. *Draft 1994-1996 Transportation Improvement Program for the Twin Cities Metropolitan Area*, St. Paul, Minnesota, 17 June 1993.

Metropolitan Washington Council of Governments. *Unified Planning Work Program for Transportation Planning for the Metropolitan Washington Region, FY 1994*, National Capital Region Transportation Planning Board, Washington, D.C.

Meyer, Barbara, Brevard County, telephone interview with author, 4 October 1993.

Miller, Phil, Karla Allen, Frederick Rivera, and Robert Soderberg. *Pedestrian and Bicycle Collisions with Motor Vehicles in King County*, King County Roadshare Program, Seattle, Washington, 1991.

Moffat, John M. *Bicycle Traffic Enforcement Policy*, September 1992.

National Capital Region Transportation Planning Board. *Transportation Improvement Program for the Washington Metropolitan Region, FY 1993-98*, Metropolitan Washington Council of Governments, Washington, D.C., 21 October 1992.

National Center for Health Statistics. 1990. *Current Estimates from the National Health Interview Survey, United States, 1985*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Washington, D.C., publication no. GPO 017-022-9799-0.

National Center for Statistics and Analysis. *1991 Pedalcyclists Fatal Crash Facts*, National Highway Safety Administration, Washington, D.C., 1992.

Nationwide Personal Transportation Survey. Federal Highway Administration, "Highway Statistics 1990." Arlington, VA: National Technical Information Service. Report No. PB-92-23-59-44XSP.

Niemeier, Debra, and G. Scott Rutherford. "Bicyclist Field Counts in the Puget Sound Area and Spokane: Data Summary and Analysis (Draft) (unpublished manuscript, 1994).

Niemeier, Debra, and G. Scott Rutherford. "National Personal Transportation Study: Non-Motorized Transportation." Federal Highway Administration, Washington D.C., December 1994.

Ohrn, Carl E. "Predicting the Type and Volume of Purposeful Bicycle Trips." *Transportation Research Record,* Vol. 570 (1976).

Olson, Jeff, City of New York, telephone interview with author, 26 October 1993.

O'Neill, Bill, telephone interview with author, September 1993.

Patten, Robert S., and Hal Hiemstra. *Enhancing America's Communities—A Nationwide Survey of the Transportation Enhancements Provisions of ISTEA*, Rails-to-Trails Conservancy, July 1993.

Pena, Nelson. "Get to Work: Now is the Time to Promote Bike Commuting." *Bicycling* 33, no. 5 (June 1992): 34-36.

Pisarski, Alan A. *Commuting in America: A National Report on Commuting Patterns and Trends.* Westport, CT: Eno Foundation for Transportation, Inc., 1987.

Plumb, Chris, Maricopa Association of Governments, Transportation and Planning Office, telephone interview with author, 18 October 1993.

Puget Sound Regional Council. *Draft 1994-1996 Regional Transportation Improvement Program (TIP), Volume I, Program Summary and List of Projects,* Seattle, Washington, 31 August 1993.

Puget Sound Regional Council. *Draft 1994-1996 Regional Transportation Improvement Program (TIP), Volume II, Project Descriptions*, Seattle, Washington, 31 August 1993.

Rails-to-Trails Conservancy. *A Nationwide Survey of the Transportation Enhancements Provisions of ISTEA, Executive Summary*, Washington, D.C., July 1993.

Research Triangle Institute. 1990. "Nationwide Personal Transportation Survey, User's Guide to the Public Use Tapes," FHWA Report No. FHWA-PL-92-0077, Research Triangle Park, N.C.: RTI, 1991.

Revised Code of Washington (46.04.200-46.61.780).

Robinson, Steven, University of Washington Police Department, telephone interview with author, 20 October 1993.

Rogers, Lisa. *Results of our 1992 Observations, Observed bicycle helmet usage patterns for Seattle 1992, Children and Adults*, Harborview Injury Prevention and Research Center, Seattle, Washington, 19 January 1992. Memo.

Sacramento Area Council of Governments. *Transportation Improvement Program, 1992*, Sacramento, California

Saibel, Charles, Washington Traffic Safety Commission, telephone interview with author, 6 May 1993.

San Diego Association of Governments. *Transit Projects, 1992-99 TRIP-San Diego Region*, San Diego, California, 23 July 1993.

Smith, Daniel T. "Planning and Design of Bicycle Facilities: Pitfalls and New Directions." *Transportation Research Record* 743, Washington, D.C. (1982): 3-8.

Southeastern Wisconsin Regional Planning Commission. *Transportation Improvement Program for the Milwaukee Transportation Management Area: 1993-1998*, Milwaukee, Wisconsin, 2 December 1992.

Stutts, Jane, Joseph E. Williamson, and Frank C. Sheldon. "Bicycle Accidents: An Examination of Hospital Emergency Room Reports and Comparison with Police Accident Data." *Transportation Research Record 1168* (1987).

Thompson, Diane, Robert S. Thompson, and Frederick P. Rivera. "Incidence of Bicycle-Related Injuries in a Defined Population." *American Journal of Public Health* 80, no. 11 (November 1990): 1388-1390.

Thompson, Robert S., Frederick P. Rivera, and Diane C. Thompson. "A Case-Control Study of the Effectiveness of Bicycle Safety Helmets." *New England Journal of Medicine* 320 (25 May 1989): 1361-1367.

Tolley, Rodney. *The Greening of Urban Transport: Planning for Walking an Cycling in Western Cities.* Great Britain: Belhaven Press, 1990.

Traffic Record Data Center. *1991 Traffic Collisions in Washington State, Data Summary and Problem Analysis*, Washington Traffic Safety Commission, Olympia, Washington, July 1992.

"A Trend on the Move: Commuting by Bicycle: An Overview of the Future of Cycling as Transportation." McCullagh, J. ed. Emmaus, Pennsylvania: Rodale Press, 1991.

University of California, Davis, *UC Davis Bicycle Programs,* Transportation and Parking Services, May 1993. Brochure.

Untermann, Richard K. *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling.* New York: Van Nostrand Reinhold Company, 1984.

U.S. Department of the Interior. 1982. "Trails for All Americans: The Report of the National Trails Agenda Project." Washington, D.C., U.S. DOI National Park Service and American Trails, 1990.

U.S. Department of Transportation, *A Summary of the Intermodal Surface Transportation*

*Efficiency Act of 1991, prepared for Washington.* Washington, D.C., 1992. Brochure.

Vance, Stephen, San Diego Association of Governments, telephone interview with author, 29 July 1993.

Vatova, Karen, City of New York, Department of City Planning, telephone interview with author, 20 October 1993.

Vesenka, Mary H. *Oahu Bicycling Education and Encouragement Program, Including Bike Ed Hawaii, Covering the Period April 1, 1992-June 30, 1992*, Kailua, Hawaii.

Voccia, Joe, Department of Public Transportation, State of Illinois, telephone interview with author, 21 October 1993.

Walzack, Keith, Department of Transportation, City of Tucson, telephone interview with author, 19 October 1993.

The Washington ISTEA Steering Committee. *ISTEA Handbook*, Washington Transportation Policy Institute, Seattle, Washington, n.d.

Washington State Department of Transportation. "Facilities for Non-motorized Transportation." 1020. Olympia, Washington, June 1989.

Washington State Transportation Policy Plan Subcommittee on Bicycle Transportation *Washington State Transportation Policy Plan*, Final Report #FMEDOREP.91-2. Olympia, Washington, August 1991.

Washington State Transportation Policy Plan Subcommittee on Bicycle Transportation. *Washington State Transportation Policy Plan*, August 1991.

Washington Traffic Safety Commission. *Traffic Collisions in Washington State: Data Summary and Highway Safety Problem Analysis*. Olympia, Washington, July 1994.

Wickstrom, George V. , P.E., Transportation Planning Consultant. *Summary and Recommendations, Travel Survey Needs, Final Report*, Metropolitan Washington Council of Governments National Capital Region Transportation Planning Board, financed in part through a grant from the U.S. Department of Transportation under the Federal Transit Act Amendment of 1991, Washington D.C., 21 June 1993.

Williams, John, "Reviewing the '81 AASHTO Guide," *Bicycle Forum* 26 (November 1990).

Wisconsin Department of Transportation. *Appendix L: Projects Selected by the Wisconsin Department of Transportation for Federal Fiscal Year 1993 Congestion Mitigation/Air Quality (CMAQ) Funding; Table A-1: Transportation Improvement Program for the Milwaukee Transportation Management Area—Milwaukee County by Implementing Agency 1993-1998*, Wisconsin Department of Transportation and SEWRPC, n.d.

## Appendix A. Selected Bicycle Education and Enforcement Programs

| Program Sponsor | Description | Notable Results/Program Features |
|---|---|---|
| City of Ann Arbor, Michigan | In 1980, the City of Ann Arbor received a grant to set up a bike patrol for the summer months. The patrol's goal was to reduce the number of bicycle traffic violations and to encourage bicycle commuting. The bike patrol circulated throughout the city, verbally warning violators and distributing pamphlets to the general public. | To determine the bike patrol's effect on the volume of traffic violations, four intersections with high violation rates were observed every two weeks throughout the summer. The average number of wrong-way bicyclists decreased throughout the summer, from 45 to 30, for a total reduction of 33 percent. However, the average number of bicyclists disregarding stop signs and traffic signals remained approximately the same. The bike patrol felt that if they had been allowed to cite violators, rather than just warning them, they would have been more effective.[1] |
| University of Washington<br>Seattle, Washington | Bicycle ridership at universities is often higher than that of surrounding areas, and violation rates are correspondingly high. At the UW, about 3,400 students ride their bikes to campus; this figure represents about 10 percent of the student population.[2] In the past, the University's bicycle enforcement program was passive, involving voluntary bicycle registration and impounding of illegally parked bicycles. Since 1990, the enforcement program has been stepped up. Two University police officers now patrol the campus on mountain bikes. Their duties include talking to bicyclists who are caught violating traffic laws. Bicyclists are only cited as a last resort. | During the first three weeks of the 1993 academic year, four citations were issued to bicyclists for illegal passing, and 23 citations were issued for failure to stop at a stop sign. Six bicycle-pedestrian collisions were reported to the University police in 1992, and four were reported in 1993. A walk-only zone in the central campus areas during class breaks has been instituted. |

1 Lagerwey and Pendleton 1981
2 Williams 1993

## Appendix A. Selected Bicycle Education and Enforcement Programs (cont'd)

| Program Sponsor | Description | Notable Results/Program Features |
|---|---|---|
| Pennsylvania Department of Transportation | The "Look Out" campaign targets pedestrians, motorists, bus riders, and bicyclists. Part of the campaign consists of a curriculum module and video for elementary school children. This educational program encompasses a wide range of bicycle projects. For kindergarten through third grade, the lessons stress the importance of helmets, bicycle care, sidewalk riding, hand signals and hazard detection. Topics for grades four through six include helmets, bicycle parts and maintenance, riding with traffic, proper signaling, obeying traffic signs, appropriate speeds, and yielding to the right-of-way. | Public information and educational materials are aimed at school-age bicyclists and their parents. They include brochures on helmet fit, equipment selection, the importance of visibility, and the rules of the road. Bicyclist "driver's licenses" imprinted with the rules of the road, calendars with safety tips, monthly activities organized around various safety themes, and a traveling quiz-show called "Wheel Wise" are other components of the "Look Out" campaign. |
| Cascade Bicycle Club, Washington State | The Cascade Bicycle Club offers the community a number of educational programs. The club sends speakers to individual classrooms or youth groups to present information on bicycle safety and the importance of wearing helmets. | The club has a library of video tapes, slide shows, and written materials geared to various age groups. A masked safety crusader named "Sprocket Hero" is available to visit grades K-6 for special assemblies. The club also offers 21- to 35-hour "Effective Cycling Courses" for youth and adults. |
| Harborview Injury Prevention and Research Center, Seattle, Washington | In 1986, in conjunction with the Cascade Bicycle Club, the Harborview Injury Prevention and Research Center kicked off the Washington Children's Bicycle Helmet Campaign, intended to reduce head injuries due to bicycle-related trauma. | The program targeted schools and parents as role models and was able to make helmets available at a significant discount. Since program inception, helmet use among children has increased from 1 percent to 40 percent, and bicycle-related head injury admissions to Harborview have declined by more than 50 percent.[3] |

3 Rogers 1992

**Appendix A. Selected Bicycle Education and Enforcement Programs (cont'd)**

| Program Sponsor | Description | Notable Results/Program Features |
|---|---|---|
| City of Oahu, Hawaii | BikeEd Hawaii was launched in 1989 to provide public school students with on-bicycle safety training.[1] Seven BikeEd instructors teach the five-hour program to fourth graders. Bicycles, helmets, and safety vests are provided during the training. This program reaches nearly 8,000 students in 104 schools each year. The total cost of the program for the 1991-92 fiscal year was $156,884. Most of the expenses went to pay the director's and instructors' salaries. Operating and equipment costs amounted to $27,812. The program was provided to the children free of charge. | Although it is difficult to measure the long-term effects of such a program, initial results are favorable. In 1990, students were given a preliminary test of 20 questions covering safe bicycling and traffic behavior. A random sample of 547 students was pre-tested, and the average score was 75 percent correct. The same students were tested after completing the program; the post-training average was 90 percent correct. Improvements in the children's bicycle riding skills were also noted in the on-road portion of the test. Parents surveyed one year following their children's participation in the program reported that riding on the correct side of the road and helmet use had increased. |
| State of Montana | The state of Montana requires safety education in every school; the bicycle safety component is optional. The program focuses on on-bike training, in response to seven broad categories of bicycle-motor vehicle accidents.[2] | Program developed by the State Superintendent of Instruction. |

1 Vesenka 1992
2 Washington State Transportation Policy Plan 1991, 12

## Appendix A. Selected Bicycle Education and Enforcement Programs (cont'd)

| Program Sponsor | Description | Notable Results/Program Features |
|---|---|---|
| The University of California, Davis | Over 15,000 students, faculty, and staff ride their bicycles to campus on any given weekday during the fall and spring quarters. Bicyclists outnumber pedestrians 4:1. During the 1960s, the City of Davis implemented a community-wide bike lane and bike path system. It is estimated that as many as one-quarter of all vehicle trips in the city are made by bicycle. Responsibility for bicycle traffic enforcement on campus is shared by the University Police Department and the Department of Transportation and Parking Services.[3] | One full-time uniformed bicycle officer from the Department of Transportation and Parking Services patrols the campus issuing citations or warnings for equipment violations and for operating an unlicensed bike on campus. University students may pay a lower fine in exchange for participating in a bike safety class. Additional officers from the University Police Department patrol the campus core on mountain bikes. Their duties include enforcement and bike theft investigation. Over 1,000 bikes are stolen each year, and the recovery rate is between 20 percent and 30 percent, thanks to the bicycle registration requirement. |
| University of Colorado, Boulder | The University cooperated with the City of Boulder in a bicycle headlight education campaign in 1992. Safety seminars emphasizing the importance of bicycle lights were held on campus. Brochures containing discount coupons for both bicycle headlights and taillights were distributed. In addition, students were warned that the law requiring the use of bicycle lights would be enforced. | During the first week, bicyclists without lights received warnings. Thereafter, when violators were ticketed, they were given the choice of either participating in a safety seminar and equipping their bikes with lights, or paying the fine. A before-and-after study on bicycle light usage is underway. Preliminary results indicate a significant increase in the use of bicycle lights.[4] |

3 University of California, Davis 1993
4 Johnson 1993

**Appendix B. How Selected Metropolitan Planning Organizations (MPOs) Allocated ISTEA Funding for Bicycle-Related Projects in FY 1993**

| Metropolitan Planning Organization | STP Enhancement Funds Allocated to Bicycle Projects | Percentage of Total STP Enhancement Funds Allocated to Bicycle Pojects | STP General Category Funds Allocated to Bicycle Projects | CMAQ Funds Allocated to Bicycle Projects | Percentage of All CMAQ Funds Allocated to Bicycle Projects | Total ISTEA Funds Allocated to Bicycle Projects | Number of Projects | Sample Projects |
|---|---|---|---|---|---|---|---|---|
| **Washington, D. C.** (MWCOG) | -0- | -0- | -0- | $3.0 million | 35% | $3.0 million | 6 | Bicycle trail construction<br>Bicycle facilities at park-and-ride lots |
| **San Diego** (SAOG) | $2.0 million | 43% | -0- | $0.5 million | 10% | $2.5 million | 11 | Bicycle lane construction<br>Bikeway and trail design<br>Bicycle path acquisition and construction<br>Bicycle route signage and improvements |
| **Milwaukee** (SWRPC) | $0.4 million | 10% | -0- | $0.6 million | 4% | $1.0 million | 7 | Bicycle system plans<br>Bikeway construction<br>Bicycle signage and mapping<br>Improved bicycle access to transit |
| **Tampa** (HCMP | $0.3 million | 10% | -0- | $0.2 million | -0- | $0.5 million | 3 | Bicycle trails<br>Bicycle racks on buses |
| **Phoenix** (MAOG) | -0- | -0- | -0- | $0.3 million | 2% | $0.3 million | 6 | Bikeway striping<br>Signage<br>Bicycle lane construction |

**Appendix B How Selected Metropolitan Planning Organizations (MPOs) Allocated ISTEA Funding for Bicycle-Related Projects in FY 1993 (cont'd.)**

| Metropolitan Planning Organization | STP Enhancement Funds Allocated to Bicycle Projects | Percentage of Total STP Enhancement Funds Allocated to Bicycle Projects | STP General Category Funds Allocated to Bicycle Projects | CMAQ Funds Allocated to Bicycle Projects | Percentage of All CMAQ Funds Allocated to Bicycle Projects | Total ISTEA Funds Allocated to Bicycle Projects | Number of Projects | Sample Projects |
|---|---|---|---|---|---|---|---|---|
| Chicago (CATS) | $2.2 million | 35% | | $1.2 million | 2% | $3.4 million | 25 | Bikeway design and construction |
| Denver (DRCOG) | $1.9 million | 100% | -0- | -0- | -0- | $1.9 million | 7 | Bicycle route signage<br>Bikeway construction<br>Intermodal facility development<br>Sidewalk improvements |
| Phoenix (MAOG) | -0- | -0- | -0- | $0.3 million | 2% | $0.3 million | 6 | Bikeway striping<br>Signage<br>Bicycle lane construction |
| Sacramento (SACOG) | $2.0 million | 43% | $0.8 million | $0.8 million | 11% | $3.6 million | 7 | Right-of-way acquisition<br>Bicycle path construction<br>Bicycle lane additions<br>Bicycle racks on buses<br>Bicycle safety and education<br>Bikeway improvements |
| Seattle (PSRC) | $2.2 million | 15% | -0- | $0.92 million | 8% | $3.2 million | 21 | Bicycle path construction<br>Bicycle-pedestrian bridge and tunnel construction<br>Bicycle racks on buses<br>Bicycle plan development |

## Appendix C. Innovative Means by which State and Local Governments Fund Bicycle Projects

| Source | Where Practiced? (Example) | Description | Sample Projects/ Outcomes |
|---|---|---|---|
| Refinancing and Combined Capital Improvements | Tucson, Arizona | The City of Tucson generated additional transportation funds by refinancing an existing bond program. The refinancing generated $11 million, of which the bicycle program received $0.5 million. However, Tucson typically incorporates its bikeways into roadway projects, so there is no direct bicycle facility cost. When streets are retrofitted, the cost of restriping/ resurfacing is funded through the City's maintenance program. If a bicycle project is funded by the City, it is usually listed under the capital improvements program and is allocated highway-user revenue funds. In 1992, $0.24 million was allocated to bicycle projects under the capital improvement program.[1] | Roadway retrofitting and restriping for bicycle use |
| Multiple Funding Sources | Seattle, Washington | The City of Seattle uses a variety of funding sources for its bicycle projects. For example, it used over 17 different sources to construct the four-mile Seattle portion of the Duwamish Trail. Direct funding sources included ISTEA moneys and revenue from bonds, such as the King County Open Space Bond, passed in 1989. This bond allows $117 million to be spent over five years for the protection and use of open space in the metropolitan area. Seattle received $5.8 million from the bond and spent $1.2 million on the Duwamish Trail. Miscellaneous funding sources include a street utility tax, a portion of which goes to non-motorized projects; donated right-of-way; and the state gas tax.[2] | Duwamish Trail |
| Piggybacking | Seattle, Washington | A majority of bicycle project funding is indirect, as bicycle projects are "piggybacked" onto other transportation projects. For example, a bikeway from Seattle to Bellevue on I-90 was constructed as part of a larger bridge corridor improvement, the total cost of which was around $13 million. | I-90 Bikeway |

1 Walzack 1993
2 Lagerwey 1993

**Appendix C Innovative Means by which State and Local Governments Fund Bicycle Projects (cont'd.)**

| Source | Where Practiced? (Example) | Description | Sample Projects/ Outcomes |
|---|---|---|---|
| Bonds | New York City | New York City has a goal of building a 350-mile bikeway/walkway network. To fund this effort, the City is using moneys from its capital budget and funds obtained via the State Environmental Bond Act, passed in 1988 to meet the local match for nearly $4 million of ISTEA moneys. | 350-mile bikeway/walkway network |
| Dedicated Allocations | Portland, Oregon | The City's bicycle program receives a minimum of 1 percent of the City's general transportation funding (approximately $0.3 million per year). The pedestrian program also receives at least 1 percent of the state gas tax. | City bicycle rack and locker program |
| Automobile Title Transfer Fees | Illinois | Illinois's State Department of Conservation receives $2 out of each automobile title transfer fee, which it then uses for the engineering, acquisition, and construction of bicycle paths. Roughly half of these funds are to be spent on trail development and maintenance at state facilities. The remainder is allocated to a matching grant fund, the Illinois Bike Path Grant Program, for use by local governments for trail acquisition and development. The Bike Path Grant Program requires a 50 percent local match, but it may be used to meet federally required local matching funds. | Acquisition of over 280 miles of bicycle trails |
| Roadway User Taxes | Iowa | The State of Iowa appropriates $1 million annually for multiple use trail acquisition, engineering and construction. The Iowa State Department of Transportation receives these funds from roadway user taxes and in turn distributes the funds to cities and counties in the form of grants that require a 25 percent local match. There are so many grant applications that only 8-10 percent can be funded. The state is hopeful that ISTEA funds will relieve some of the backlog. | Multiple-use trail acquisition, engineering, and construction<br>Demand for funds greatly exceeds supply |

**Appendix C  Innovative Means by which State and Local Governments Fund Bicycle Projects (cont'd.)**

| Source | Where Practiced? (Example) | Description | Sample Projects/ Outcomes |
|---|---|---|---|
| Cigarette Tax, Lottery Tax, and Oil Overcharge | Minnesota | The state of Minnesota has undertaken a major bicycle project: The Paul Bunyan Trail, a multi-use facility ten feet wide and 100 miles long. the Department of Natural Resources acquired this trail through appropriation of $1.8 million from the capital budget, $0.7 million from the cigarette tax, and $0.6 million from the environmental trust fund. The cigarette tax and the environmental trust fund are administered by the Legislative Commission of Minnesota Resources (LCR), which recommends to the legislature projects that preserve and develop the state's environment and resources. The LCR's last biennial budget contained $14.6 million from the cigarette tax, $24.6 million from the environmental trust portion of the lottery, and $2 million from the oil overcharge | The Paul Bunyan Trail, a multi-use facility 10 feet wide and 100 miles long |
| Gas Tax | Oregon | After the cities and counties of Oregon have received their share of the gas tax, the state spends a minimum of 1 percent of the remaining revenues on the development of footpaths or bikeways. The funds, which amount to approximately $3 million per year, may only be used for facilities within highway rights-of-way. | Since program inception in 1971, over 530 miles of bikeways have been constructed, not including the Oregon Coast Bicycle Route and shoulder improvements. |
| Developer Requirements | Brevard County, Florida (Tampa) | A Brevard County ordinance requires that both residential and commercial developers build sidewalks and bicycle paths along their properties and that they link them to the county road. This requirement cannot be waived; if the facilities are already built, or if it is not feasible to build them at the time, the developer is assessed the cost of building sidewalks and bike paths, and that money goes to a district trust fund, from which such facilities can be built in the future. | Sidewalks and bike paths that connect with county roads are built at all new commercial and residential developments. |

**Appendix C Innovative Means by which State and Local Governments Fund Bicycle Projects (cont'd.)**

| Source | Where Practiced? (Example) | Description | Sample Projects/ Outcomes |
|---|---|---|---|
| Municipal Service Taxing Units (MSTU) and Municipal Service Benefit Units (MSBU) | Brevard County, Florida (Tampa) | The MSTU is a tax paid by all property owners to their district for municipal services, including the bikeways and pedestrian facilities that are required on most road resurfacing projects and all new road projects. The MSBU is a short-term tax targeted to a specific project. | Bikeways and pedestrian facilities on most road resurfacing projects and all new road projects |
| Public-Private Partnerships | Montgomery County, Maryland | This county is converting an abandoned rail corridor into a bicycle/pedestrian trail. The 3.4-mile Capitol Crescent Trail connects two Metro stops and will become part of a twelve-mile system of trails inside the Capitol Beltway. Funding for the trail came from ISTEA enhancement funds ($0.87 million), from Maryland National Capitol Park and Planning (in the form of design and paving services worth $0.2 million (Check: In kind?); $110,000 from PEPCO, $40,000 in storm-water management, and $6 million right-of-Way from Montgomery County. ). | 3.4-mile Capitol Crescent Trail, a bicycle-pedestrian facility |
| Sales Tax | San Diego County, California | San Diego County allocates a 0.25-cent sales tax to a transportation development fund and a 0.50-cent tax to a second transportation fund. For 1994, San Diego County allocated about $2 million from both funds for bicycle and pedestrian projects. | Bicycle loop detectors<br><br>Bike path and lane construction<br><br>Bikeway studies<br><br>Bicycle safety education |

# About the Innovations Unit

The Innovations Unit is an advisory group to the Washington State Transportation Commission that conducts technology and policy research on emerging transportation developments and opportunities in Washington State. The goals of the Innovations Unit are to

- provide long-range program development support to the Transportation Commission,
- generate unfiltered visions of a wide range of future short-term and long-term transportation technology and policy options, and
- establish a research methodology that fosters development of innovative transportation concepts.

The Innovations Unit has three objectives representing successively more detailed and focused studies:

**Objective 1.** **Monitor emerging technologies and strategies.** Compile and synthesize up-to-date information about emerging and innovative transportation technologies, strategies, and policies.

**Objective 2.** **Research selected topics of Commission interest.** Conduct detailed background research of specific technology and policy issues, under the direction of the Commission's Policy Development Subcommittee. Produce a series of white papers outlining technology and policy implications germane to the Washington State transportation system.

**Objective 3.** **Support in-depth technology and policy research.** Conduct and/or coordinate detailed research of key enabling technologies, strategies, and policies.

The research activities of the Innovations Unit emphasize early, preparatory studies of emerging potential transportation solutions, and include interaction with elected officials, public agencies, university researchers, the private sector, and members of the public. Its activities are intended to complement and support in-depth applied research and implementation by the Washington State Department of Transportation (WSDOT) through its Research Office, and reinforce ongoing State Transportation Policy Plan activities.