# BIKEWAY DEVELOPMENT STUDY REPORT

# TO

# THE GOVERNOR

# AND

# THE GENERAL ASSEMBLY OF VIRGINIA


**HOUSE DOCUMENT NO. 5**

COMMONWEALTH OF VIRGINIA
Department of Purchases and Supply
Richmond
1974 75

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF HIGHWAYS & TRANSPORTATION
1221 EAST BROAD STREET
RICHMOND 23219



October 1, 1974

TO: Honorable Mills E. Godwin, Jr., Governor of Virginia
and
The General Assembly of Virginia

It is a pleasure to submit, on behalf of the Virginia Department of Highways and Transportation, this agency's Bikeway Development Study which is in response to House Joint Resolution No. 224 enacted by the 1973 session of the Virginia General Assembly.

The report was developed based on extensive research of reports and investigations by various agencies, firms, educational institutions and individuals in other states, information solicited from governing officials of the cities, towns and counties throughout Virginia and a thorough analysis of the bicycle accident statistics of the Virginia Department of State Police. The conclusions and recommendations within the report reflect the judgment of the Virginia Department of Highways and Transportation.

This has been a most interesting assignment. We hope the results of our study will be of benefit to you as consideration is given to the development of bikeways in Virginia.

Sincerely,

Douglas B. Fugate

Douglas B. Fugate, Commissioner

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# Summary Of Findings, Recommendations

## SUMMARY OF FINDINGS, RECOMMENDATIONS

The growing popularity and use of bicycles is unquestioned. The Bicycle Institute of America estimated that in 1960, 20 percent of the population of the United States bicycled regularly; by 1970, this estimate had risen to 37 percent. If the percentage of bicycle users continues to increase at its present rate, approximately 60 percent of the nation's population will be bicyclists by 1980.

In Virginia in 1972, there were more than 2,000,000 bicycle users; residents owned approximately 1,400,000 bicycles and approximately 317,000 new bicycles were sold.

This increased use has resulted from a number of factors, including the desire for outdoor recreation, the need to conserve gasoline, and concern about air pollution from motor vehicles. While there has been an increased use of bicycles by commuters, the larger use is, and is likely to remain, for recreational purposes.

But at the same time, a significant and consistent annual increase in bicycle-motor vehicle accidents has occurred. A total of 2,955 such accidents was reported in the four-year period ending December 31, 1972. Forty-three persons were killed and 2,953 were injured. Provision of adequate safety must be a prime concern in consideration of the overall subject.

Already, the Department of Highways and Transportation is involved in construction of commuter bikeways, and has established guidelines for development of such facilities. It considers construction of such bikeways for commuter purposes an appropriate use of revenue from highway user taxes. However, it has no authority to expend funds for bikeways which are generally recreational in nature and would require an independent right-of-way.

With this brief summary of findings, which are discussed further in subsequent sections of this report, the Department submits the following recommendations to the Governor and the General Assembly:

1. Bicycle-riding, for both commuter and recreational purposes, has increased sharply in recent years. Thus, there is a need for greater governmental attention to the provision of safe, adequate facilities for the use of bicycles.
2. The distinction between commuter and recreational bicycle facilities should be clearly recognized.
   (a) The Department of Highways and Transportation already is engaged on a limited basis in development of such facilities for commuter purposes, financing them with highway funds in a manner identical to that followed in financing of highway improvements. The Department will continue this policy.
   (b) The Virginia Commission of Outdoor Recreation or some other appropriate state agency should be given authority to assist localities in development of recreational bikeways, with these facilities financed from a combination of funding sources.
3. In all instances, the planning of bicycle facilities should be a matter of local initiative, and should remain primarily at the local level.

   The continuing, cooperative, comprehensive transportation planning process conducted jointly by the Department of Highways and Transportation and the localities will in the future include consideration of bicycle plans for commuter purposes.
4. Adequate provision must be made for maintenance of completed bicycle facilities.

5. A statewide system of bicycle facilities is not recommended at this time due to the physical problems of establishing routes and the complexities of identifying bicycle facilities on a statewide basis.
6. It is not desirable to divert a specific portion of highway user tax funds to finance bicycle facilities. The Department of Highways and Transportation already is utilizing such funds to construct bikeways on a project-by-project basis, and should retain sufficient flexibility in funding to meet genuine public needs.

# Introduction

## PURPOSE

House Joint Resolution 224 of the 1973 General Assembly directed the Department of Highways and Transportation to conduct a study on the feasibility of establishing a system of bicycle routes throughout the Commonwealth and to include the consideration of diverting a portion of highway funds for this purpose or to identify other means of financing. The resolution directed that this study be conducted and recommendations submitted to the Governor and General Assembly by October 1, 1974.

For the purposes of this report, the term "bikeways" refers to all applicable bicycle routes. The bikeway may take the form of a bicycle trail, a bicycle lane or a shared roadway.

This study evaluates: the growing interest in bicycling as documented by various statistics; the planning of various bikeway facilities; the design of bikeway geometrics and traffic controls; bikeway costs; and potential sources of funding for bikeways. In addition, recommendations are presented which might be utilized to assist in the development of bikeways in the Commonwealth of Virginia.

Minibikes, motorized scooters, motor bikes, mopeds, etc., are not within the definition of a bicycle and should not be sanctioned on bicycle facilities. Bikeways discussed in this study do not incorporate provisions for these types of motorized vehicles.

# HISTORY

The bicycle has developed during the past two centuries through the achievements of various inventors. In 1791, it was a primitive toy, called a celerifere in France and referred to as a dandy horse or hobby horse in Great Britain, where it was very popular. Known as the first practical bicycle, it had two wheels propelled by the rider's feet thrusting at the ground.

A few years later, a treadle arrangement was designed and it was proven that two wheels in line could be vertically balanced. The treadle concept was soon discarded with the development of a better pedal. The vehicle was then called a velocipede. Thus, in the early 1860's, the era of cycling began.

There were many improvements to the bicycle in the late 1800's. Utilizing mass production techniques, a dramatic drop in the price of the bicycle resulted in America's first bicycle "boom".

Perhaps the best known of the early bicycles is the ordinary or high wheeler, which had a large front wheel and a small rear wheel.

Around the turn of the century, there were so many bicycles on the streets that speeds were controlled and licenses required. The early bicyclists had to contend with poor streets -- muddy, dusty and furrowed with wagon tracks. It was for the purpose of improving bicycling conditions that the League of American Wheelmen was formed. It was partly responsible for the U.S. Office of Road Inquiry, which was set up to assist colleges and experimental stations in road studies. This influenced the development of the nation's highways. Although most of the paved roads were of cobblestones, the bicyclists, led by the 40,000-member League of American Wheelmen, lobbyed for lighted streets, street name signs at intersections and laws for bicycling.

In the early years of bicycling, the wagon roads, carriage routes and local streets were used. Seattle, Washington, was among the first to build

bicycle trails, having constructed over 20 miles by 1889. Bicycle trails were also constructed in California and in Florida during the late 1800's and early 1900's.

There are many reasons for bicycling's early popularity. People found it to be inexpensive, enjoyable, physically beneficial, easily mastered by children and adults alike, relatively safe and noise-free. At the turn of the century, bicycling in America had evolved from a mere recreational pastime to a common mode of transportation.

Then came the horseless carriage in the early 1900's. Bicycles identified the need for roads, initiated the development of mass production techniques and provided many of the inventions used for the early automobile. Soon bicycle shops and hostels were transformed to accommodate the needs of the horseless carriages and the motorists. Thus, talent and money were transferred from the bicycle to the automobile. The bicycle was neglected for the automobile's range, convenience, carrying capacity and popularity.

Between the early 1900's and 1960, bicycles were most popular as a means of transportation and recreation by children. During this time, the use of the bicycle declined, except for short periods of popularity during the Depression Years and World Wars I and II, when fuel was scarce.

The current popularity, beginning in the early 1960's, is attributed to the appearance of the lightweight multispeed bicycle. As this type became available and public attitudes changed toward recreation and conservation, bicycle ownership grew. The ten-speed vehicle was marketed in 1960 and the fifteen-speed in 1967. Bicycle sales surpassed automobile sales in the United States in 1972, with approximately 13.9 million bicycles being sold.

In Virginia today, there are nearly 100 miles of bikeways and in the United States, over 3,000 miles. Many additional bikeways are being planned in

conjunction with other transportation facilities. The popularity of the bicycle is expected to continue unabated in the years immediately ahead.

## STUDY PROCEDURE

To develop this study, reports and investigations conducted by various agencies, firms, educational institutions and individuals in other states were considered. Interviews were conducted with federal officials, consultants and highway officials throughout the country who are currently involved in the planning, location or construction of bikeways. A number of discussions have been held with bicycle enthusiasts to obtain insight into the problems and concerns of the bicyclists.

Questionnaires were sent to the governing officials of the cities, towns and counties in Virginia and to state and federal park officials. The responses furnished data on existing and planned bikeways and other information useful to the study.

The bicycle accident statistics were acquired through the official records of the Department of State Police.

The Virginia Commission of Outdoor Recreation's "Demand Survey", published in 1973, supplied data on the desires and needs of the Commonwealth's citizens. This report serves as a basis to establish initial desires for recreational bikeways in the Commonwealth.

The American Association of State Highway and Transportation Officials' (AASHTO) report titled Guide for Bicycle Routes has been most valuable in developing design criteria for bikeways.

The information made available from all sources has been thoroughly considered in the preparation of this report. In the current planning, design and

construction of bikeways, there has not been sufficient background to fully identify and develop acceptable standards. In this study, which reflects the experience and judgment of many, refinement in procedures and adjustments in the design criteria, warrants and traffic controls can be expected as knowledge is gained through experience.

## DEFINITIONS

A number of studies of bicycle routes have been conducted, and in several instances, slightly different interpretations have been made of the type of bicycle facility described. To eliminate the possibility of misinterpretation, the definitions of the terms used herein are as follows:

Bicycle - A device having two-wheels tandem, propelled exclusively by human power upon which a person may ride. For purposes of this study, three-wheeled non-motorized cycles are included.

Bikeway - Also referred to as a bicycle route or bicycle way is any road, street, path or way which is specifically designated as being open to bicycle travel, regardless of whether such facility is designated for the exclusive use of bicycles or is to be shared with other transportation modes.

Bicycle Trail - A separate trail or path which is generally for the exclusive use of bicycles. Where such trail is a part of a highway, it is separated from the roadway for motor vehicle traffic by an open space or barrier.

Bicycle Lane - A portion of a roadway which has been designated generally for the exclusive use by bicycles. It is distinguished from the portion of the roadway for motor vehicle traffic by paint stripes, curbs, parking blocks or other similar devices.

Shared Roadway - A roadway which is officially designated and marked as a bicycle

route but also is open to motor vehicle travel. No provision is made for physical separation of the travel modes.

# Planning Of Bikeways

## BICYCLE AND BIKEWAY STATISTICS

### Bicycle Growth Rate

The extraordinary increase in the popularity of the bicycle began in the late 1950's but has only reached such tremendous proportions in the last few years. The Bicycle Institute of America has estimated that in 1960, 20 percent of the U.S. population bicycled regularly; furthermore, in 1970, it was estimated that there were 75 million cyclists (37 percent of the population) in the United States. If the percentage of bicycle users continues to climb at its present rate and as shown in Figure 1, approximately 60 percent of the U.S. population should be bicyclists by 1980.

PERCENTAGE OF BICYCLE USERS TO TOTAL UNITED STATES POPULATION

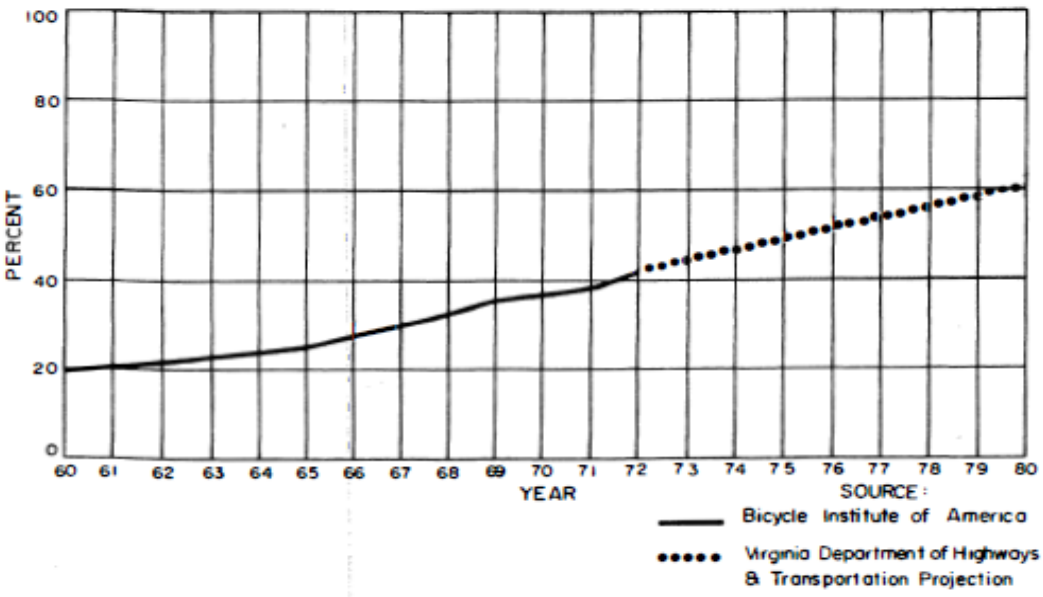



**FIGURE 1**

Pertinent statements regarding the bicycle growth rate include:

1. The percentage of bicycle users to the total population has increased from 20 percent in 1960 to 37 percent in 1970 and is forecasted to reach as high as 60 percent by 1980 in Virginia and the nation. This forecast is highly speculative and dependent partly upon national economic conditions.

2. The sale of new bicycles at the national level has increased from 3,700,000 units in 1960 to 13,900,000 units in 1972 and is forecasted to reach approximately 22,100,000 units by 1980.

3. In Virginia in 1972, there were over 2,000,000 bicycle users, residents owned approximately 1.4 million bicycles and approximately 317,000 new bicycles were sold.

Bicycle Accidents

Virginia accident statistics reveal a consistent and significant annual increase in bicycle-motor vehicle accidents. From the analysis of the official State Police records for the four-year period from January 1, 1969 through December 31, 1972, there was a total of 2,955 reported bicycle-motor vehicle accidents. During this four-year period, there were 43 persons killed and 2,953 persons injured in bicycle-motor vehicle accidents. Overall, 80 percent of the accidents occurred during daylight hours, nearly 6 percent occurred at dusk, less than 1 percent at dawn, 9 percent at darkness in locations where lighting was provided and 4 percent during darkness. The number of accidents remained rather constant throughout the week, with Tuesdays and Saturdays having a peak of 16 percent of the accidents and with only 11 percent of the accidents occurring on Sundays.

In 1972, with 840 reported bicycle-motor vehicle accidents, there were 10 bicyclists killed and 786 bicyclists injured. Approximately 74 percent of these accidents were primarily attributable to the bicycle operator. Furthermore, 50 percent of the fatalities were in the 10-14 age group and 30 percent in the 15-19 age group. Of the 786 bicyclists injured, 67 percent were from 5 to 14 years of age and 17 percent were in the 15 to 19 age group. The majority

of bicycle-motor vehicle accidents in Virginia are non-fatal ones involving male cyclists 5 to 14 years old and occurring in urban areas during favorable light and weather conditions. With the frequency of bicycle accidents among school-age children, the knowledge of traffic laws should be programmed to their level. Also, a more stringent enforcement of these laws in relation to the bicyclist is necessary.

A preliminary review indicated that during 1973, 22 persons were killed in bicycle-motor vehicle accidents. These fatalities represent a 120 percent increase over the 10 deaths which occurred during calendar year 1972.

Existing and Planned Bikeways

The mileage of the bikeways presently operational and those which are currently planned or under construction was determined from the Department's bikeway questionnaire which was completed by officials of cities, towns and counties in Virginia and state and federal park officials.

The statistics submitted in responses to these questionnaires revealed:

1. As of September, 1973, there were 63 miles of bicycle trails, 2.4 miles of bicycle lanes and 31.6 miles of shared roadways operational in Virginia and usage ranged from 6 to 441 bicycles during typical 12-hour weekday counts.

2. As of September, 1973, there were 399 miles of bikeways planned or under construction, consisting of 218 miles of bicycle trails, 52 miles of bicycle lanes and 129 miles of shared roadways.

## SELECTION AND USE OF BIKEWAYS

A bikeway is defined as any road, street, path or way which is specifically designated as being open to bicycle traffic, regardless of whether such a facility is designated for the exclusive use of bicycles or is to be shared with other transportation modes. In developing bikeways, any one or a combination of three types of facilities might be selected. They include: the bicycle trail,

the bicycle lane or the shared roadway. The ultimate selection of a given type of bikeway facility should be based on a variety of factors including safety, individual site conditions and cost.

Some advantages and disadvantages associated with each type of bikeway are shown in Table 1.

TABLE 1
ADVANTAGES AND DISADVANTAGES OF VARIOUS TYPES OF BIKEWAYS

| ADVANTAGES | DISADVANTAGES |
|---|---|
| **TRAIL** | |
| 1. Separates bicycles and motor vehicles. | 1. An expensive facility to develop. |
| 2. Minimizes exposure of bicyclists to undesirable vehicle emissions and noise levels. | 2. Time interval to develop facility may be longer, particularly if right-of-way must be acquired. |
| 3. Provides scenic routes detached from highway corridors. | 3. Enforcement of bicycle ordinances and protection from criminal offenses may pose problems. |
| **LANE** | |
| 1. Psychologically separates bicycle traffic from motor vehicle traffic. | 1. Additional right-of-way may be required if street widths are inadequate and parking provisions cannot be modified. |
| 2. Offers a wide variety of design alternatives, depending on parking provisions. | 2. Conflicts between bicyclists and parked vehicles may occur. |
| 3. Facilitates enforcement of bicycle ordinances. | 3. On-street parking may have to be modified. |
| **SHARED ROADWAY** | |
| Least expensive facility to develop. | 1. Least amount of protection for bicyclist. |
| No new right-of-way required. | 2. Hazardous roadway conditions may need to be corrected, particularly where sight distance is restricted. |
| Maintenance costs are minimal. | |
| Facilitates enforcement of bicycle ordinances. | 3. Cannot be used except in those areas where vehicular speeds and volumes are low. |

Responses to the Department's bikeway questionnaire indicated that as of September, 1973, the Commonwealth's bikeways were utilized as shown in Table 2.

TABLE 2
COMMONWEALTH OF VIRGINIA
EXISTING AND PLANNED BIKEWAY MILEAGE AND USAGE

| Type of Bikeway | Recreational | Commuting | Recreational & Commuting | Total |
|---|---|---|---|---|
| Trail (Existing) | 35.7 Mi. | 1.3 Mi. | 26.0 Mi. | 63.0 Mi. |
| Lane (Existing) | 2.4 Mi. | 0.0 Mi. | 0.0 Mi. | 2.4 Mi. |
| Shared Roadway (Existing) | 26.1 Mi. | 4.5 Mi. | 1.0 Mi. | 31.6 Mi. |
| Sub-Total (Existing) | 64.2 Mi. | 5.8 Mi. | 27.0 Mi. | 97.0 Mi. |
| Trail (Planned or Under Construction) | 134.0 Mi. | 0.0 Mi. | 83.9 Mi. | 217.9 Mi. |
| Lane (Planned or Under Construction) | 0.0 Mi. | 0.0 Mi. | 51.7 Mi. | 51.7 Mi. |
| Shared Roadway (Planned or Under Construction) | 52.4 Mi. | 0.0 Mi. | 77.0 Mi. | 129.4 Mi. |
| Sub-Total (Planned or Under Construction) | 186.4 Mi. | 0.0 Mi. | 212.6 Mi. | 399.0 Mi. |
| Total | 250.6 Mi. | 5.8 Mi. | 239.6 Mi. | 496.0 Mi. |

## LOCATING BICYCLE FACILITIES

Design factors to be considered when planning bikeway facilities are: (a) length of bikeway, (b) terminal points, (c) expected bicycle volume, (d) existing routes, (e) aesthetic values and (f) points of interest. Adaptable locations which might easily be developed into bicycle trails with more alterations are:

1. Abandoned railroad rights-of-way.
2. Telephone line, powerline and gas pipeline rights-of-way provide more than adequate clearances for bicycle trails. Grades may or may not be within grade specifications.
3. Riverbanks, beach fronts, embankments and flood control levees usually provide long and gently curved scenic locations for bicycle trails.
4. National, state, regional and local parks and forest preserves offer

scenic and historic locations for bicycle trails as well as recreational facilities and terminal parking lots for bicyclists.

5. Abandoned roadways when their short lengths might provide adequate services.

6. Fire breaks offer sufficient widths and clearances for bicycle trails. There may be excessive grades in mountain forests which could be restrictive in design.

7. Sidewalks or pedestrian walkways in areas of low pedestrian volumes may easily be converted to bikeways when permitted by local ordinance.

## BIKEWAY WARRANTS

The Virginia Department of Highways and Transportation has developed ırrants to guide the safe development of bikeways in the Commonwealth. The :partment's bikeway warrants are based upon vehicular traffic volumes and ıeeds as related to bicycle usage. Table 3 describes these warrants.

TABLE 3
VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
WARRANTS FOR BIKEWAYS

| TYPE OF BICYCLE FACILITY | | SHARED ROADWAY | LANE | TRAIL |
|---|---|---|---|---|
| :hicular ADT | | 0 - 2,000 | 2,000 - 8,000 | 4,000+ |
| :hicular Speed | | 35 or Less | 45 or Less | 45 or More |
| :commended .nimum ›ad .dth | Parking Both Sides | 44 Feet | 52 Feet | |
| | Parking One Side | 34 Feet | 43 Feet | |
| | No Parking | 24 Feet | 34 Feet | |
| ›solute .nimum ›ad Width | Parking Both Sides | 44 Feet | 47 Feet | |
| | Parking One Side | 32 Feet | 38 Feet | |
| | No Parking | 20 Feet | 29 Feet | |
| .nimum Vehicle Stopping .ght Distance | | 263 Feet | 369 Feet | |

ıe criteria herein are developed from current standards and are to be considered .exible within limits of safety and professional judgment. These initial warınts are subject to modification as experience is gained.

## BIKEWAY SYSTEM PLANNING

A bikeway should accommodate as many bicyclists' interests as possible, provide continuity of purpose and satisfy bicyclists' desired corridors of travel. Three types of functional bikeway systems include:

1. Local bikeway systems for small geographic areas, such as small towns, sections of a city or residential subdivisions, which provide access to residential areas, schools, churches, local parks, public facilities and neighborhood shopping areas.

2. Urban bikeway systems for travel between small adjacent communities or within large urban/suburban areas which provide access to high density residential areas, colleges, urban parks, entertainment or recreational facilities, major commercial areas, employment centers or interconnected local or regional systems.

3. Regional bikeway systems primarily for recreational users and occasionally for commuters who travel between large urban/suburban areas, outlying fringe areas, rural areas or recreational areas.

Bikeways are further categorized by use as recreational and commuter. Recreational bikeways are generally located in park-like settings and are established to fulfill the basic need of recreation and physical exercise. Planning activities should be related to the recreational programs administered by the Virginia Commission of Outdoor Recreation; the Virginia Department of Conservation and Economic Development, Division of Parks; and regional and local park and recreational authorities.

Commuter routes are more characteristic of urban travel patterns and are most often found routed in some form along highway facilities. Consequently, planning activities for commuter bikeways should be locally sponsored and appropriately directed to the Virginia Department of Highways and Transportation for consideration of the development of transportation corridors.

There are no definite minimum or maximum lengths for bikeways. Two general guidelines, however, are: commuter routes are seldom used if the distance from origin to destination exceeds 7 miles; touring routes in regional bikeway systems

should be at least 15 miles in length to properly serve bicyclists' purposes.

To be effective, bicycle routes must provide continuity of purpose and satisfy the bicyclists' desired corridors of travel. The planning for a bikeway should originate at the local level with involvement by local elected officials, planners, engineers, recreation officials, members of local cycling clubs and civic groups, to determine the most feasible locations and solicit public support and use. As local systems develop, consideration should be given to interconnecting them with urban and regional bikeway systems. All local bikeway systems should be approved by the local elected officials in order to assume local support and participation in any eventual construction. In planning and developing these more comprehensive bikeway systems, cooperation and coordination among local officials, park and recreational officials and appropriate state agency officials is required.

For all types of bikeways, planning should initiate at the local level, where local desires are well established. The appropriate state agencies are then in position to better deal with a locally approved plan. Thus, locally approved plans can also be directly applied to any forthcoming requirements or control strategies of the U.S. Environmental Protection Agency.

# Design Of Bikeways

## GEOMETRICS

Design criteria are generally described to meet the objectives of planning and developing bikeways. The principal comments describing various design elements follow:

### Speed

The average bicycle speed is 10 to 11 miles per hour. The Department concurs with the following recommendations of the AASHTO Guide for Bicycle Routes: 10 miles per hour for minimum design speed; 15 miles per hour for normal design speed on level grades; 20 miles per hour or more for the design speed on downgrades.

### Grade

The AASHTO Guide advocates minimizing gradients at the expense of additional curves and distances. Generally, the greater the grade, the shorter the section should be.

Ten percent is considered the maximum grade, but on long grades, 5 percent is the upper limit. The AASHTO Guide recommends 10 percent as the absolute maximum grade for very short distances. A series of conforming grade sections alternating with horizontal sections may be used where the desired elevation cannot be attained with one grade section.

Rest stops may be provided along overly steep grades. Bicycle lanes and shared roadways must be located with consideration to gradients of existing roads.

### Curvature

A radius of curvature should be that in which a cyclist can comfortably make a 180 degree turn without feeling the necessity to apply brakes. The Department recommends an absolute minimum radius of 15 feet for a design speed of 10 miles per hour.

Superelevation

The minimum acceptable superelevation rate is 0.02 foot per foot. The Department suggests a maximum superelevation rate of 0.3 foot per foot.

The length of a superelevation runoff should vary from a maximum of approximately 100 feet for high superelevation rates to a minimum of approximately 10 feet for low superelevation rates.

Horizontal and Vertical Clearances

The recommended minimum width of a one-way bicycle lane, considering maneuvering distances is 4 feet, while 3.5 feet is the absolute minimum. A two-lane bikeway pavement should be 8 feet wide with a total horizontal clearance of 12 feet.

A widening of the pavement of up to 2 feet is suggested on curves with a radius of less than 50 feet where the design speed is 10 miles per hour or greater.

For bridges and tunnels, the Department recommends a 10-foot width due to the confining nature of these structures. A vertical clearance of 10 feet is desired on all structures.

Drainage

For bicycle trails, a surface with a transverse slope of 0.250 to 0.375 inches per foot is recommended by the Department and the AASHTO Guide. Even though several states found a ditch section 1 foot wide and 1 foot deep with 2:1 side slopes sufficient, drainage should be evaluated on an individual basis for each bikeway project. For bicycle lanes and shared roadways, existing drainage systems are normally satisfactory except for grate covers of storm drains, which might have to be modified.

Pavement Design

Construction specifications for the paving of bikeways are much the same

as the construction specifications for asphalt or concrete sidewalks, driveways or light-duty roads. Gravel, dirt, clay, grass or turf surfaces are rarely feasible because of their innate instability. The Department recommends asphalt or concrete surfaces. Other less expensive alternatives are a 3"-4" aggregate base of gravel, crushed stone or slag topped with a 1½"-2" regular asphalt surface or a 4" lime-treated subbase topped with a 2" rich asphaltic concrete surface.

Cross Sections

A. Trails

Independent Right-of-Way - The desirable trail width is 4 feet for one-way and 8 feet for two-way bicycle operation. The trail is on its own right-of-way and is for the exclusive use of bicycles.

Within Existing Highway Right-of-Way - The desirable trail width is 4 feet for one-way and 8 feet for two-way operation with separation of 20 feet (minimum) or 30 feet (desirable) between the highway and the bikeway. If this separation is less than 4 feet, installation of a barrier may be in order.

Shown in Figure 2 is a typical bicycle trail.

B. Lanes

Between Parking Lanes and Travel Lanes - A bicycle lane 3.5 to 4.0 feet wide should be utilized with 1.0-foot wide striping on either side of the bikeway.

Overlayed Shoulder - A bicycle lane 3.5 to 4.0 feet wide with a 1.0-foot stripe separating the bicycle lane and the highway plus a 1.0-foot shoulder might be utilized when there is a minimum shoulder width of 6.0 feet.

Elevated Above Roadway - A bicycle lane may be raised several inches above the vehicular traffic lanes. This is similar to a sidewalk where the curb thus acts as a separator.

Roadway Width - Parking conditions influence the required roadway widths for bicycle lanes as follows:

| | RECOMMENDED MINIMUM WIDTH | ABSOLUTE MINIMUM WIDTH |
|---|---|---|
| 1. Parking Both Sides | 52 Feet | 47 Feet |
| 2. Parking One Side | 43 Feet | 38 Feet |
| 3. No Parking | 34 Feet | 29 Feet |

Shown in Figure 3 is a typical bicycle lane.

C. Shared Roadways

On a shared roadway, only signing is used to distinguish the bike route from any other road or street. Since the lanes on a shared roadway are not specified for the exclusive use of either bicycles or motor vehicles, moderate vehicle speeds and adequate sight distance is essential.

Parking conditions influence the required roadway widths for shared roadways as follows:

| | RECOMMENDED MINIMUM WIDTH | ABSOLUTE MINIMUM WIDTH |
|---|---|---|
| 1. Parking Both Sides | 44 Feet | 44 Feet |
| 2. Parking One Side | 34 Feet | 32 Feet |
| 3. No Parking | 24 Feet | 20 Feet |

Shown in Figure 4 is a typical shared roadway.

TYPICAL BICYCLE TRAIL

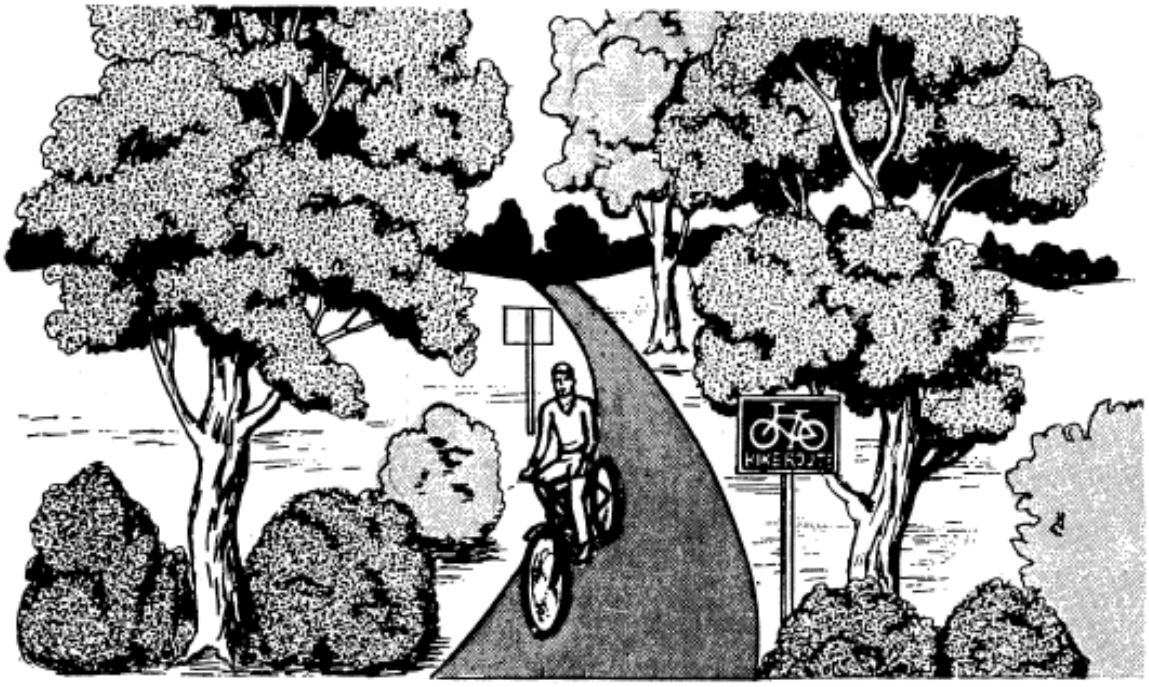


FIGURE 2

TYPICAL BICYCLE LANES CONSTRUCTED ON OVERLAYED SHOULDERS

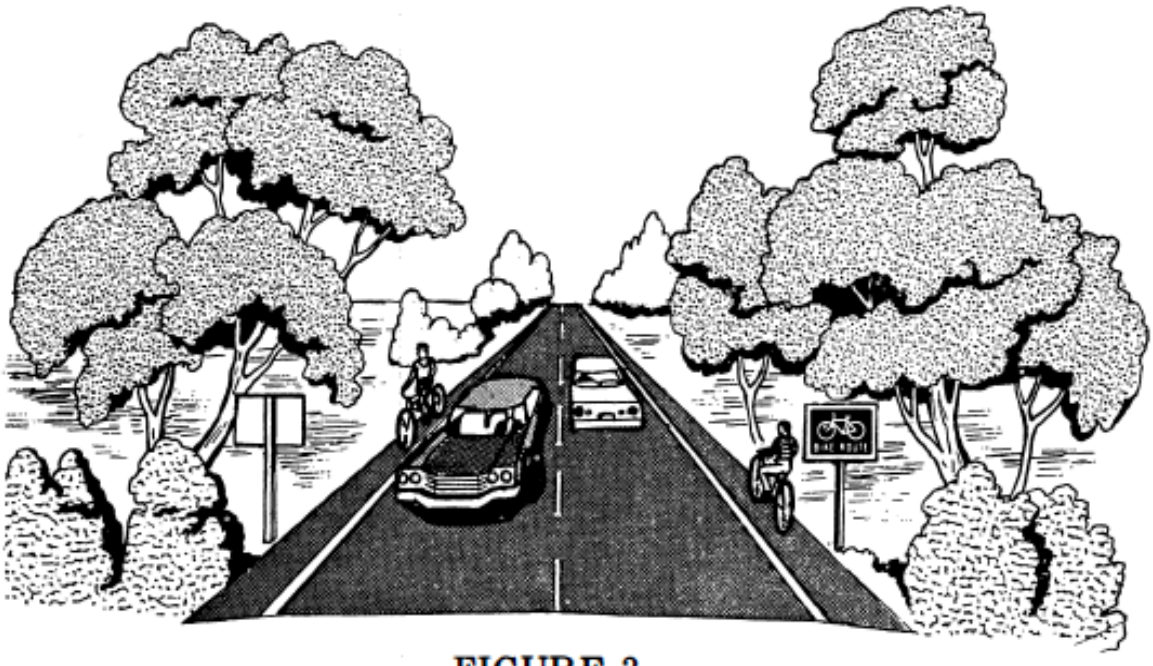


FIGURE 3

**TYPICAL SHARED ROADWAY**

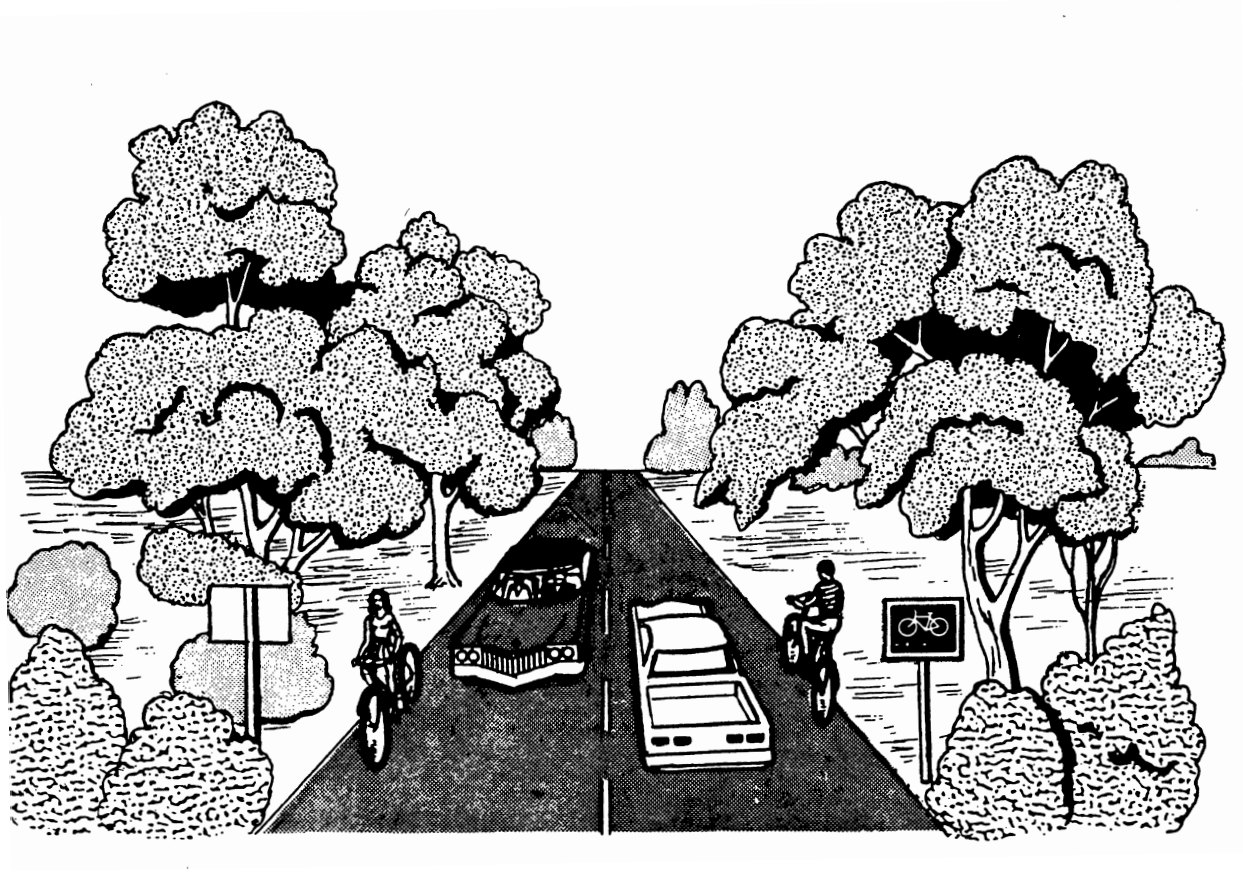


**FIGURE 4**

## TRAFFIC CONTROLS

### At-Grade Intersections

The number and severity of conflicts between motorists, bicyclists and pedestrians is far greater at intersections than at other locations; thus, utmost care must be taken in designing intersections which are to accommodate bicycle traffic. Existing at-grade street intersections must be designed using channelization consisting of some form of striping or marking which clearly delineates the path bicycles must take in crossing intersections. It should be emphasized that the efficiency of various at-grade intersection designs depends to a large extent on bicyclists and motorists staying within their defined right-of-way.

The Virginia Department of Highways and Transportation has developed typical channelization layouts for bicycle lanes carried through intersections on roadway where parking is either permitted or prohibited and for a bicycle trail crossing a street or highway between intersections. These layouts are depicted in Figures 5 through 7. As more bikeways become operational, experience will be acquired to facilitate the development of additional standards.

### Grade-Separated Crossings

The most efficient way to prevent conflicts between bicyclists and motorists at intersections is to provide grade separation. Grade separations must be considered whenever a bikeway crosses a highway with full access control or where a combination of vehicular/bicycle volumes and speeds dictates such a facility. In grade-separated crossings, bicyclists' requirements with respect to grade, turning radius, width, superelevation and speed, as well as the grade profiles on structure approaches, must be considered.

The selection of an overpass or underpass depends primarily on individual site characteristics and economic considerations. For bikeway overpasses, key

## TYPICAL CHANNELIZATION FOR BICYCLE LANES CARRIED THROUGH INTERSECTION ON ROADWAY WHERE PARKING IS PERMITTED

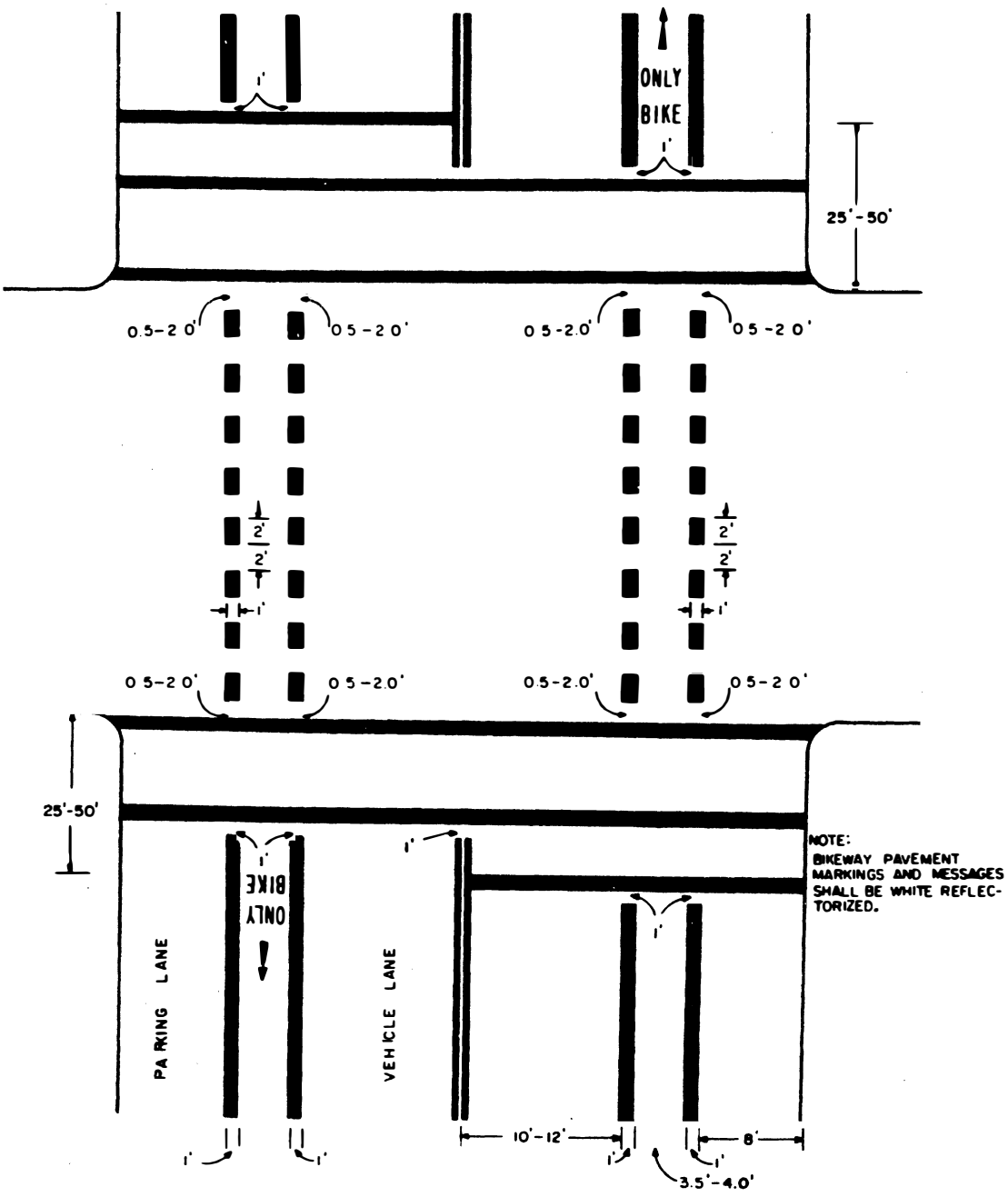



FIGURE 5

## TYPICAL CHANNELIZATION FOR BICYCLE LANES CARRIED THROUGH INTERSECTION ON ROADWAY WHERE PARKING IS PROHIBITED

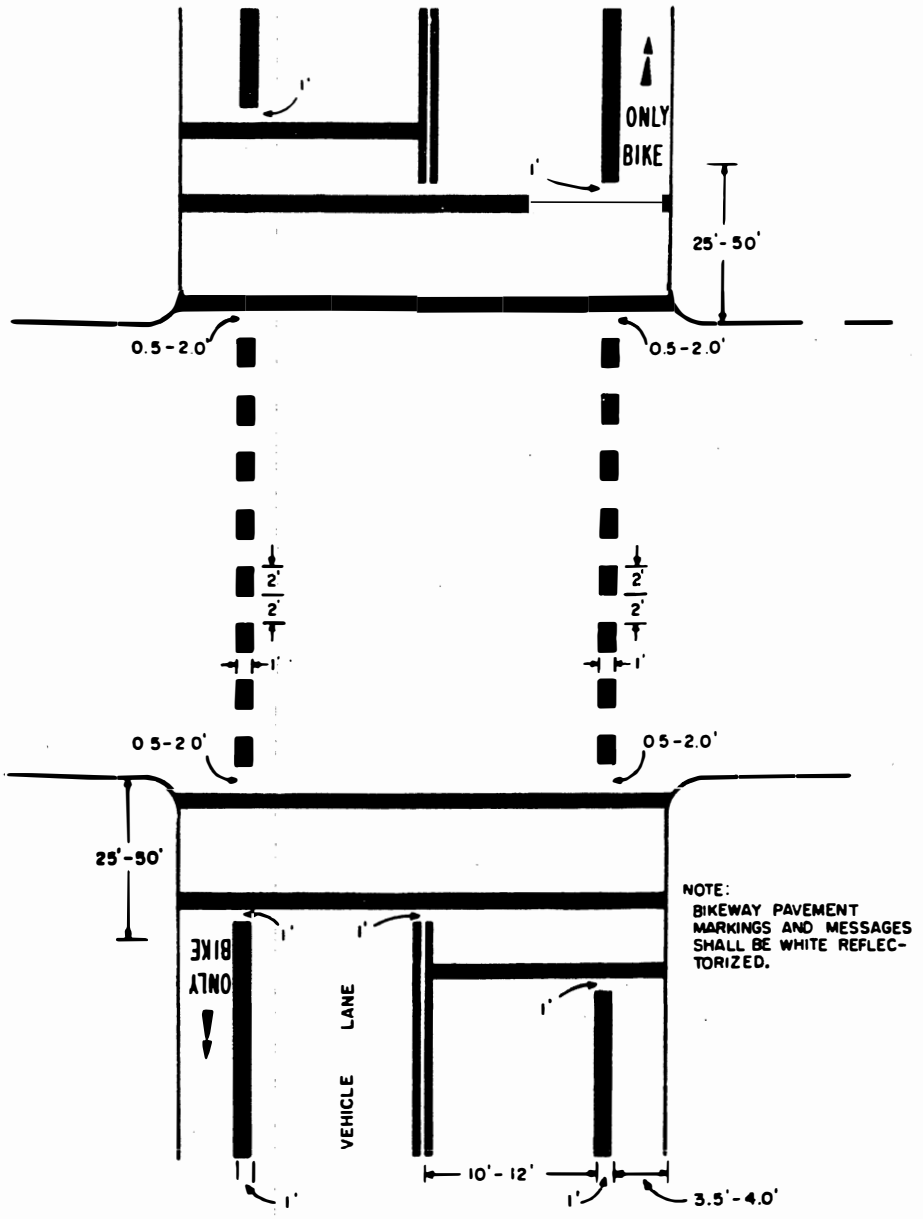



FIGURE 6

TYPICAL CHANNELIZATION FOR BICYCLE TRAIL
CROSSING STREET OR HIGHWAY BETWEEN INTERSECTIONS

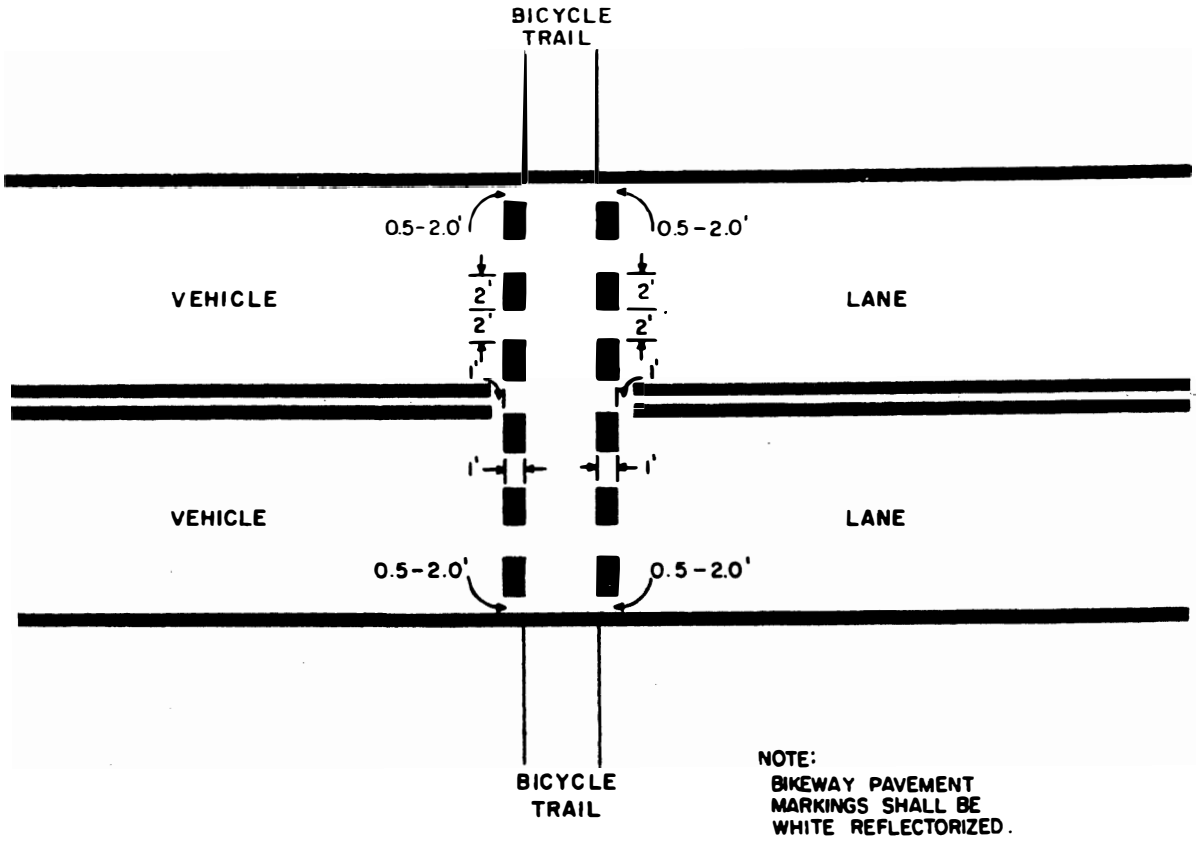



FIGURE 7

considerations are width of roadway and the grade differential at which it is spanned, while those for underpasses are groundwater conditions and the presence of underground utilities.

Crossing of Highway Bridges

Although bridges are a small portion of a bikeway, they exhibit special safety problems to the bicyclist.

There are four ways a depression or obstruction can be spanned by a bikeway which parallels a highway bridge. They include:

1. Using an existing bridge if of sufficient width,
2. Widening an existing bridge if it has a concrete or steel barrier adjacent to the edge of the traveled roadway,
3. Providing a cantilevered platform on each side of an existing bridge structure for bicyclists, and
4. Constructing a separate bikeway bridge away from the highway bridge.

Traffic Signals

In some instances, it may be necessary to modify existing traffic control devices to insure the safe and efficient flow of bicyclists, pedestrians and motor vehicles. Some of the modifications to traffic signals might include:

1. Providing detectors sensitive to bicycles (such as the push-button type),
2. Providing an increased amber phase to allow bicyclists to clear the intersection,
3. Providing an all red phase to allow bicyclists to clear an intersection, and
4. Providing additional signal phases and signal heads to control motor vehicle, bicycle and pedestrian movements.

The effectiveness of utilizing any of these alternatives must be made on an individual basis at each signalized intersection.

Signs

Signs and pavement markings supplement the geometric design of bikeways and

highways by adding to the safety and efficiency of these transportation facilities. Bikeway signs must be standardized to provide universal comprehension and understanding by bicyclists and motorists alike. Signs consist of three general types which include:

1. Regulatory signs which inform motorists and bicyclists of traffic laws or regulations,
2. Warning signs which are used when it is deemed necessary to warn motorists or bicyclists of hazardous situations, and
3. Guide signs which direct motorists or bicyclists along a route to a destination.

The Virginia Department of Highways and Transportation has adopted as standard signs for bikeways the signs that are presently prescribed in the Manual on Uniform Traffic Control Devices published by the U. S. Department of Transportation. These designated signs are represented in Figure 8.

The Virginia Department of Highways and Transportation has also adopted special bikeway signs which are to be included in the Virginia Manual of Uniform Traffic Control Devices. These designated signs are depicted in Figure 9.

The "Standard" and "Special" bikeway signs mentioned are intended to be utilized in addition to the signs presently contained in the Virginia Manual where applicable.

Since unconstrained bicycle speeds on level grades average 10 miles per hour as compared to over 30 miles per hour for motor vehicles on surfaced streets, it is urged that guide signs which relate specifically to bicyclists be more closely spaced than comparable signs required for automobile traffic. Sign locations would depend upon the nature of the bikeway route, conflict points and other decision points.

All signs directed toward motorists should be reflectorized for adequate nighttime visibility. The illumination of individual bicyclist directed signs on bikeways may be required as the situation demands, depending upon the anti-

cipated nighttime usage and the adequacy of existing illumination in the vicinity of the sign.

## STANDARD BIKEWAY SIGNS


(D11-1)

LEGEND WHITE (REFLECTORIZED)
BACKGROUND. GREEN (REFLECTORIZED)


(W11-1)

LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: YELLOW (REFLECTORIZED)


(R5-6)

CIRCLE AND DIAGONAL: RED (REFLECTORIZED)
SYMBOL,BORDER, LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: WHITE (REFLECTORIZED)


(R5-10)

LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: WHITE (REFLECTORIZED)


(R5-10)

LEGEND. BLACK (NON-REFLECTORIZED)
BACKGROUND: WHITE (REFLECTORIZED)


(R5-3)

LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: WHITE (REFLECTORIZED)

SOURCE: MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES - 1971

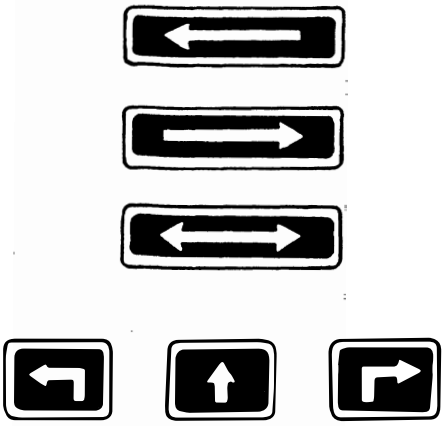
**FIGURE 8**

# SPECIAL BIKEWAY SIGNS


LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: YELLOW (REFLECTORIZED)


LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: YELLOW (REFLECTORIZED)

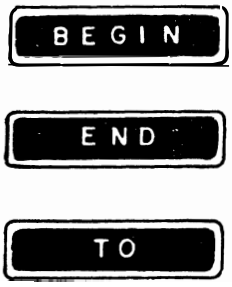

LEGEND: BLACK (NON-REFLECTORIZED)
BACKGROUND: WHITE (REFLECTORIZED)



LEGEND: WHITE (REFLECTORIZED)
BACKGROUND: GREEN (REFLECTORIZED)

TO BE MOUNTED BELOW THE OFFICIAL MARKER TO EITHER:

1. GUIDE BICYCLISTS ALONG THE BIKE ROUTE
2. PROVIDE DIRECTIONS TO THE BIKE ROUTE




LEGEND: WHITE (REFLECTORIZED)
BACKGROUND: GREEN (REFLECTORIZED)

TO BE MOUNTED ABOVE THE OFFICIAL MARKER TO EITHER:

1. DESIGNATE THE BEGINNING AND ENDING OF THE BIKE ROUTE
2. PROVIDE DIRECTIONS TO THE BIKE ROUTE

## FIGURE 9

Pavement Markings

Markings have definite function to perform in the proper scheme of traffic control. They may:

1. Serve to channelize bicyclists into exclusive bicycle lanes,
2. Delineate crossings where bicyclists cross roadways, or
3. Convey certain regulations or warnings to both bicyclists and motorists.

Markings are particularly effective on upgrades where bicyclists, preoccupied with pedaling efforts, tend to look at the pavement.

Pavement markings are particularly important for proper channelization of traffic on bicycle lanes. Outside of intersections, longitudinal pavement marking lines for bicycle lanes should consist of a solid white reflectorized line .2 inches in width. Within intersections, a white reflectorized line, 12 inches in width consisting of short segments two feet in length separated by gaps of two feet, should be utilized to delineate crossings. Solid longitudinal pavement marking lines should terminate one foot upstream from a stop bar and resume one foot downstream from the outside edge of a pedestrian crossing zone. Dotted lines should be utilized within intersections. They should not, however, intersect stop bars or crosswalk lines. Channelization layouts depicting these markings are shown in Figures 5 through 7 accompanying at-grade intersections.

A variety of pavement messages might be used as markings to regulate, guide or warn bicyclists. They include: "STOP"; "YIELD"; "YIELD AHEAD"; "BIKE ROUTE"; "BIKE WAY"; "PED XING"; "SLOW"; "BIKE ONLY"; and right, left or straight through arrows.

The Department recommends the "BIKE ONLY" white pavement message for bicycle lanes to advise motorists that bicycles are the only through traffic allowed on the bicycle right-of-way. As a minimum, this message should be located on the downstream side of intersections where bicycle lanes intersect

cross streets. This message should be contained within the longitudinal lines defining the bicycle lane by having a minimum overall width of three feet. Elongated lettering can frequently be effectively utilized with this type of pavement marking.

# Bikeway Costs

## VIRGINIA COMMISSION OF OUTDOOR RECREATION

The results of the Virginia Commission of Outdoor Recreation's survey published in May, 1973 produced support for 3,570 miles of bikeways in 1972 and 4,560 miles of bikeways by 1980. These mileages were predicted based on a total of 1,300 personal interviews in the state's 11 outdoor recreation planning districts.

The same study also showed that bicycling is the most popular outdoor recreational activity for Virginians in terms of a participation rate per capita and that bicycling is the most widely distributed of all of Virginia's outdoor recreational activities. This means that bikeways will be the most used of all outdoor recreational facilities.

## VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

To supplement information regarding the desire for bikeways and to implement the provisions of the bikeway resolution passed by the 1973 General Assembly, the Department developed and distributed a bikeway questionnaire to officials in each of the state's 64 municipalities having a population larger than 3,500 and to all of the Commonwealth's 95 counties, as well as to those officials affiliated with various federal and state parks and wildlife refuge areas. Based on a 100% response, the following information was obtained:

1. Bikeways for recreational purposes were considered feasible by officials of 67 counties and 48 municipalities representing 4,110,000 persons, or 86 percent of the state's 1972 population.

2. Bikeways for commuting purposes were considered feasible by officials of 20 counties and 25 municipalities representing 2,772,000 persons, or 58 percent of the state's 1972 population.

Information submitted on the questionnaire indicated that as of September, 1973, there were 97 miles of existing bikeways and 399 miles of bikeways which

were either planned or under construction. Even though a majority of the Commonwealth's municipalities and counties consider bikeways to be feasible, the development of bicycle facilities does not meet the Commission of Outdoor Recreation's estimate of 3,570 miles for 1972 or 4,560 miles by 1980. These existing bikeways were under the jurisdiction of 14 different municipalities, six different counties and 13 different government agencies. The bikeway questionnaire also revealed that 36 of the state's 64 municipalities in excess of 3,500 population and 33 of the state's 95 counties, or a total of 69 of the Commonwealth's 159 municipalities and counties, had a strong interest in bicycling.

The increased popularity of bicycling influences the feasibility of establishing bikeways in the Commonwealth, with the percentage of bicycle users increasing from 20 percent in 1960 to approximately 60 percent in 1980, and bicycle sales expanding from approximately 317,000 units in 1972 to more than 500,000 units in 1980.

Statistics from 1969 through 1972 indicate there was a total of 2,955 bicycle-motor vehicle accidents, of which 654 occurred in 1969, 718 in 1970, 743 in 1971 and 840 in 1972.

Environmental concerns such as fuel conservation, noise pollution and air pollution enhance the feasibility of establishing bikeways in the Commonwealth. Federal directives related to the development of bikeways are also being promulgated by the Environmental Protection Agency.

Responses from municipal and county officials, the existing deficiency in satisfying the forecasted demand mileage for bikeways, an increasing number of bicycle users and bicycle sales, a possible reduction of bicycle-motor vehicle accidents and environmental considerations all substantiate the feasibility of proceeding with the development of bikeways in the Commonwealth of Virginia. All of these factors must be considered as bikeway planning begins at the local

level. Further, extreme care in bikeway planning must be taken to balance the use of the facility with the construction cost and to minimize maintenance costs and responsibilities.

## COST OF BIKEWAYS

A number of varying factors are involved in the cost of establishing bikeways. The average cost per mile of one section may deviate significantly from the average cost of another section, as shown in Table 4.

TABLE 4
UNIT BIKEWAY CONSTRUCTION COSTS IN VARIOUS STATES

| Type of Bikeway Facility | Source | Comments | Cost Per Mile (Excludes R/W) |
|---|---|---|---|
| Bicycle Trail | Oregon | Including some grade separation structures | $38,350-$52,500 |
| | Oregon | Excluding grade separation structures | $23,300 |
| | Arlington Co., Virginia | | $ 8,000-$14,000 |
| Bicycle Lanes | Oregon | With only signing & striping required | $ 600 |
| | Oregon | Including barriers | $ 9,000 |
| Shared Roadway | Portland, Oregon<br>Arizona<br>Portsmouth, Va. | | $ 260<br>$ 1,010<br>$ 400 |
| Not Specified | Florida Study | | $10,560-$14,080 |
| Construction of Pavement Structure Only | Maryland Study | | $26,400 |

The Department has developed design standards for typical bicycle trails, lanes and shared roadways, with the cost estimates on a per-mile basis using 1972 construction prices. These cost estimates are summarized in Table 5.

TABLE 5
VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
UNIT COST ESTIMATES FOR
TYPICAL BICYCLE TRAILS, LANES AND SHARED ROADWAYS

| Description | Cost Per Mile |
|---|---|
| Bicycle Trail Two-Way (Separate from Roadway) | $38,250 |
| Bicycle Trail Two-Way (Adjacent to Roadway) | $38,250 |
| Bicycle Lanes (Between Parking Lane & Travel Lane) | $ 2,280 |
| Bicycle Lanes (Between Travel Lane & Edge of Road) | $ 1,420 |
| Bicycle Lanes (Elevated Above Roadway with Curb & Gutter & Drainage Structures) | $72,350 |
| Bicycle Lanes (Overlayed on Roadway Shoulder) | $12,180 |
| Shared Roadway | $ 950 |

The average cost for bicycle lanes is estimated to be $10,000 per mile. The cost for a bridge structure with a ten-foot horizontal clearance is $485 per linear foot. It is emphasized that these estimates are to be used only as a guide. The current economic situation in this country has so disrupted construction and maintenance operations that any cost estimates must be considered highly variable.

As an example of the potential bikeway funding involved, cost estimates have been prepared to illustrate the costs of constructing the facilities suggested in the study of the Virginia Commission of Outdoor Recreation. In order to classify types of bikeways, the following assumptions of typical usage have been utilized:

1. Fifty percent of all bike trips are for recreation purposes and 50 percent are for commuting purposes.

2. Bicyclists on recreational trips will need the following percentages of the total bikeway mileage: Bicycle Trails-60 percent; Bicycle Lanes-10 percent; Shared Roadway-30 percent.

3. Bicyclists on commuting trips will need the following percentages of the total bikeway mileage: Bicycle Trails-10 percent; Bicycle Lanes-60 percent; Shared Roadway-30 percent.

Using these assumptions and the unit costs for bikeways developed by the Department based on 1972 construction prices, the total costs to satisfy the Commission of Outdoor Recreation's bikeway mileages for 1972 and 1980 are shown in Table 6.

TABLE 6
COMMONWEALTH OF VIRGINIA
TOTAL BIKEWAY MILES AND CONSTRUCTION COSTS

| Type Bikeway | Cost Per Mile | 1972 Miles - Cost | 1980 Miles - Cost |
|---|---|---|---|
| Trail | $38,250 | 1,250 mi. $47,812,500 | 1,596 mi. $61,047,000 |
| Lanes | $10,000 | 1,250 mi. $12,500,000 | 1,596 mi. $15,960,000 |
| Shared Roadway | $ 950 | 1,070 mi. $ 1,016,500 | 1,368 mi. $ 1,300,000 |
| TOTALS: | | 3,570 mi. $61,329,000 | 4,560 mi. $78,307,000 |
| WEIGHTED COST: | $17,200 | | |

The aforementioned costs do not include right-of-way expenses or annual maintenance costs. It is anticipated that the necessary properties would be owned and/or provided by the appropriate state, county or municipal government.

No deduction was made for nearly 100 miles of bikeways which are operational in the state, since it is anticipated that these facilities may have to be modified to conform to the bikeway standards presented in this report.

An inflationary economy will increase the overall cost of the program each year that construction of bikeway facilities is deferred.

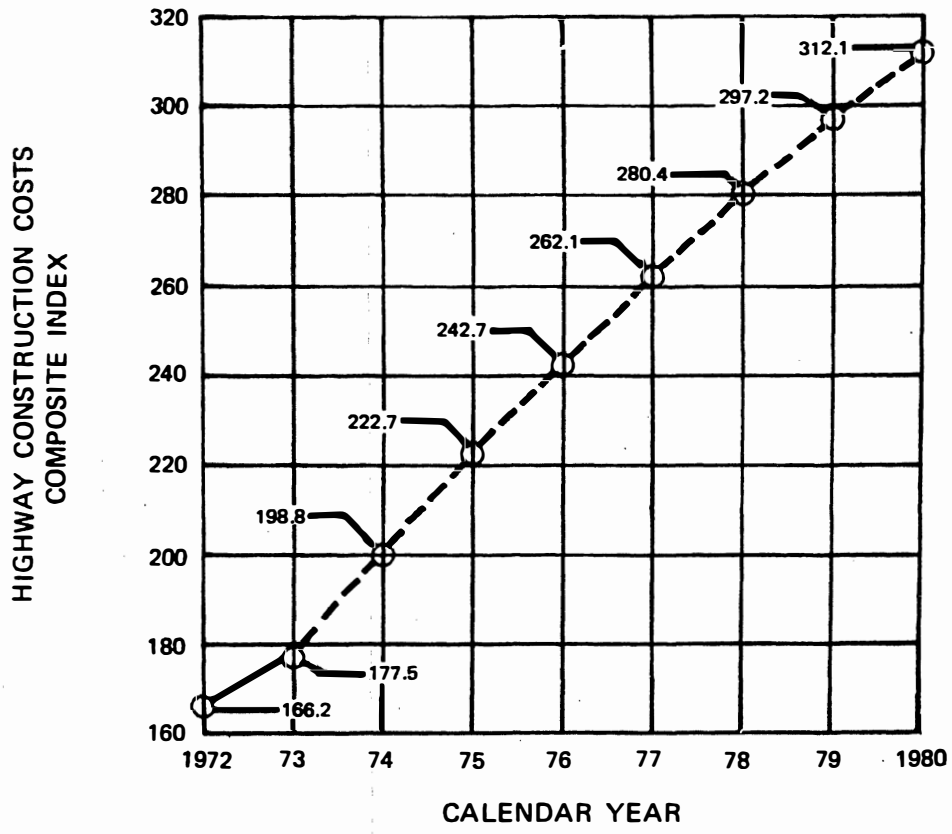
One parameter which indicates the presence of inflation in the Commonwealth

is the composite index for construction costs. The base year for computing this index is 1967. The index for that year is considered to be 100. In 1972, this index was 166.2, and in 1973, it increased to 177.5. If the economy follows this inflationary trend, the composite index may surpass 300.0 by 1980 based on forecasted annual increases utilizing the expertise and judgment of officials within the Department. This inflationary trend is depicted in Figure 10.

Figure 11 illustrates the projected devaluation of a construction dollar based on this forecasted rate of inflation. Thus, a 1972 dollar would have the purchasing power of 53 cents in 1980. Furthermore, the weighted unit construction cost for bikeways will increase 87.8 percent from $17,200 per mile in 1972 to $32,300 per mile in 1980.

# VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

## COMPOSITE INDEX FOR HIGHWAY CONSTRUCTION COST




NOTES:

1. PROJECTED COMPOSITE INDEX IS BASED ON FORECASTED ANNUAL INCREASES OF 12%, 12%, 9%, 8%, 7%, 6%, & 5% RESPECTIVELY FOR EACH YEAR FOLLOWING CALENDAR YEAR 1973.
2. — — — — ESTIMATED VALUE OF COMPOSITE INDEX.

FIGURE 10

# VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

## FORECASTED IMPACT OF INFLATION ON THE CONSTRUCTION DOLLAR

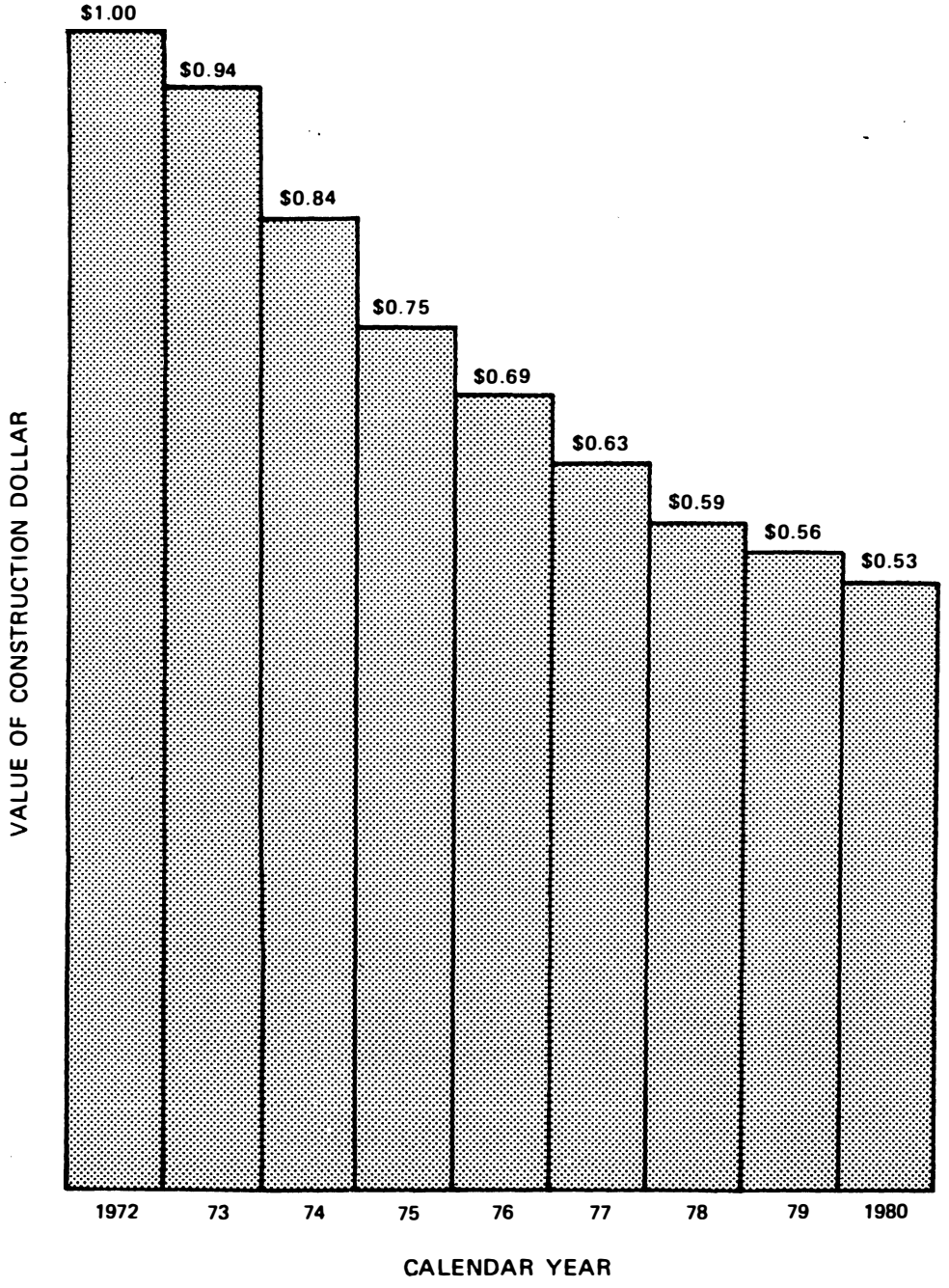



**FIGURE 11**

# Funding Of Bikeways

## INTRODUCTION

Financing is of paramount importance in the development of bikeways if their planning, design and construction is to become a reality for the two to three million bicycle users in Virginia. The approximate cost to construct the 1980 forecast for 4,560 miles of bikeways is $78,307,000, exclusive of any right-of-way expenses and annual maintenance costs. In funding such a large expenditure, it is pertinent to:

1. Review the status of existing programs which may have monies available for bikeways,

2. Discuss the use of highway funds to plan, design and construct bicycle facilities, and

3. Evaluate the feasibility of using alternate sources of funding including a motor fuel tax, general funds, revenue sharing funds, general obligation bonds, a bicycle excise tax, bicycle registration and licensing fees or a combination of funding sources to develop bicycle facilities

In evaluating the feasibility of using various funding alternatives, statistics regarding bicycle sales and bicycles in use must be utilized. These forecasts have been initially tabulated on a yearly basis from fiscal year 1960-61 through 1979-80. Table 7 briefly illustrates the long-term growth trends of bicycle sales and bicycles in use.

**TABLE 7**
**ESTIMATED GROWTH TRENDS**
**FOR BICYCLE SALES AND USE IN VIRGINIA**

| Fiscal Year | Bicycle Sales in Virginia Units | Bicycles in Use |
|---|---|---|
| 1960-61 | 87,000 | 544,000 |
| 1964-65 | 125,000 | 737,000 |
| 1969-70 | 161,000 | 1,121,000 |
| 1974-75 | 397,000 | 1,641,000 |
| 1979-80 | 497,000 | 2,354,000 |

## STATUS OF EXISTING PROGRAMS

Officials in federal and state agencies were contacted to determine the 'ailability of any monetary resources in their existing programs which might : utilized to plan, design, construct or maintain bikeways in Virginia, and ıereby diminish the necessity of establishing new bikeway funding programs. ıe results of this survey are briefly summarized in Table 8.

TABLE 8
STATUS OF EXISTING PROGRAMS

| AGENCY | OBJECTIVES | BIKEWAY DEVELOPMENT MAY ASSIST FINANCIALLY | BIKEWAY DEVELOPMENT HAS ASSISTED FINANCIALLY |
|---|---|---|---|
| .rginia Department of ›nservation and Economic :velopment | | | |
| Division of Forestry | To encourage multiple use of forest resources | X | X |
| Division of Parks | To establish outdoor recreational use of natural resources | X | X |
| .rginia Commission of ıtdoor Recreation | The creating and putting into effect a long-range plan for acquisition and development of a comprehensive system of outdoor recreation facilities. | X | |
| .rginia Department of .ghways and Transporta-.on | Existing Bikeway Program | X | X |
| palachian Regional mmission | Appalachian Development Highway System & Appalachian Local Access Roads | X | |
| S. Department of using & Urban Develop-nt, Community Develop-nt | Urban Renewal Projects | X | |

TABLE 8 (CONT.)
STATUS OF EXISTING PROGRAMS

| AGENCY | OBJECTIVES | BIKEWAY DEVELOPMENT MAY ASSIST FINANCIALLY | BIKEWAY DEVELOPMENT HAS ASSISTED FINANCIALLY |
|---|---|---|---|
| U.S. Department of Interior | | | |
| Bureau of Outdoor Recreation | Outdoor Recreation - Acquisition and Development; Outdoor Recreation - State Planning and Financial Assistance | X | |
| National Park Service | Historic Preservation Grants-in-Aid Program; To develop at Colonial National Historical Park a bikeway from Williamsburg to Yorktown, Virginia | X | X |
| U.S. Department of Agriculture, Soil Conservation Service | Watershed Protection and Flood Prevention Program | X | |
| U.S. Department of Transportation | | | |
| Federal Highway Administration | Federal-Aid Highways Emergency Relief; Federal-Aid Highway Act of 1973 | X | X |
| National Highway Traffic Administration | State & Community Highway Safety | X | |
| Tennessee Valley Authority | Water Resources Development | X | |
| Environmental Protection Agency | Air Pollution Control Program Grants | X | |

The aforementioned table shows that 10 governmental agencies have programs which may assist in the development of bikeways, but only two state agencies (the Virginia Department of Conservation and Economic Development and the Virginia Department of Highways and Transportation) and two federal agencies (the U.S. Department of Interior and the U.S. Department of Transportation, FHWA) have participated financially in the development of bikeways in Virginia in the past.

In most of the programs, bikeways must be constructed in conjunction with other capital improvements. The U.S. Department of Transportation is the only agency which has authorized the additional use of current funds to construct bikeways.

## FUNDING ALTERNATIVES

### Highway Funds

The diversion of highway funds represents one method to finance the development of bikeways in the Commonwealth of Virginia. Information from all states regarding bikeway funding indicated that five states (California, Maryland, Michigan, Oregon and Washington) have enacted legislation using highway funds to finance bikeways.

Virginia also uses highway funds to construct bikeways although a specific amount for bikeways is not allocated. Bikeways are incorporated into highway projects when officially requested by local governments; when they are part of an approved bikeway plan; and when the costs of the bikeways are absorbed into the total project cost. Local participation in funding is encouraged by incorporating bikeways in this manner, thus resulting in realistic development of construction projects which represent local investment and the interest of elected officials. Local participation amounts to 15 percent of total cost in

cities and towns over 3500 population. In a county's secondary road system, bikeways can be provided with local funding of 100 percent of the additional right-of-way costs. Primary projects are funded by the Department.

Virginia's highway funds are projected through 1980 assuming there is no increase in existing tax levies, no new programs providing additional revenues and that fuel tax revenues grow at a slower rate due to the fuel shortage. These figures are shown in Table 9.

TABLE 9
VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
PROJECTED REVENUE
(LESS INTERSTATE FEDERAL-AID)
($1,000's)

| | 1975-76 | 1976-77 | 1977-78 | 1978-79 | 1979-80 |
|---|---|---|---|---|---|
| Net State Revenue for Highways | $326,625 | $331,379 | $336,444 | $341,885 | $347,770 |
| Mass Transit - Acts of 1974 | 11,600 | 11,600 | 11,600 | 11,600 | 11,600 |
| Federal-Aid (Less Interstate Federal-Aid) | 56,128 | 56,128 | 56,128 | 56,128 | 56,128 |
| Projected Revenue (Less Interstate Federal-Aid) | $394,353 | $399,107 | $404,172 | $409,613 | $415,498 |

The Federal-Aid Highway Act of 1973 permitted states to divert not more than $2,000,000 per fiscal year in Federal-Aid Highway Funds for independent bikeways or walkways. The State Highway and Transportation Commission is using limited amounts of both federal and state funds for the construction of bikeways such as the bikeways being constructed along Arlington Boulevard in Arlington County.

Motor Fuel Tax

If the current state gasoline tax of 9 cents per gallon were increased as much as ¼ cent or ½ cent per gallon to fund the development of bikeways, the

additional revenues would be $34,653,000 or $69,306,000, respectively, by 1980. Projected revenues from the increased gasoline tax by fiscal year are shown in Table 10.

TABLE 10
PROJECTED REVENUES (1,000's)
FROM INCREASED GASOLINE TAX RATES

| FUEL TAX INCREASE | FISCAL YEAR 1975-76 | 1976-77 | 1977 78 | 1978-79 | 1979-80 | TOTAL |
|---|---|---|---|---|---|---|
| ¼¢ Per Gallon | $ 6,658 | $ 6,792 | $ 6,928 | $ 7,067 | $ 7,208 | $34,653 |
| ½¢ Per Gallon | $13,316 | $13,584 | $13,856 | $14,134 | $14,416 | $69,306 |

If Virginia were to raise its gasoline tax for the sole purpose of financing bikeways, it would be establishing a precedent except for Maryland which raised its gas tax to 9 cents per gallon to finance all types of highway improvements, including bikeways. Other states are funding bikeways with gas tax rates no higher, and in some cases lower, than Virginia's.

General Fund Revenues

General fund revenues represent a reasonable financial alternative for the development of bikeways. Even though general fund revenues have not been utilized to fund bikeways, they have been used by various agencies and local units of government to finance the development of various transportation facilities and programs in the Commonwealth. The use of these general fund revenues is summarized in Table 11.

TABLE 11
GENERAL FUND APPROPRIATIONS
FOR TRANSPORTATION FACILITIES

| Agency or Program | General Fund Appropriation 1968-70 through 1974-76 Biennium |
|---|---|
| Virginia Port Authority | $53,582,850 |
| Virginia Airports Authority | 32,000 |
| Washington Metropolitan Area Transit Commission | 742,525 |
| Northern Virginia Transportation Commission | 2,800,000 |
| State Corporation Commission (Division of Aeronautics) | 3,679,145 |
| | $60,836,520 |

With this broad dispersion of expenditures among various agencies, it is appropriate to consider using general funds to assist in the development of bicycle facilities which would be beneficial to citizens residing in all regions of the Commonwealth.

Two major sources of revenue for the state's general fund are the income tax on individuals and the sales and use tax. In the Governor's budget submitted to the General Assembly on January 9, 1974, it is estimated that these two sources of income would provide 39.0 percent and 25.8 percent respectively of the state's total general fund revenues during the 1972-74 biennium.

Since the implementation of the retail sales and use tax on September 1, 1966, estimated net revenues collected from the sale of bicycles have increased significantly. These estimated revenues and their distribution into the state's general fund in accordance with the legal statutes of the Commonwealth are depicted in Table 12.

TABLE 12
ESTIMATED SALES TAX REVENUES
GENERATED FROM THE SALE OF BICYCLES

| Fiscal Year | Bicycle Sales Units | Bicycle Sales Dollars | Net Sales Tax Revenue | Tax Revenues Deposited into State's General Fund |
|---|---|---|---|---|
| 1966-67 | 126,000 | $ 7,560,000 | $ 225,000 | $ 75,000 |
| 1967-68 | 165,000 | 9,900,000 | 295,000 | 98,000 |
| 1968-69 | 168,000 | 10,080,000 | 400,000 | 200,000 |
| 1969-70 | 161,000 | 9,660,000 | 383,000 | 191,000 |
| 1970-71 | 181,000 | 10,860,000 | 431,000 | 215,000 |
| 1971-72 | 260,000 | 15,600,000 | 619,000 | 309,000 |
| 1972-73 | 339,000 | 20,340,000 | 808,000 | 404,000 |
| 1973-74 | 372,000 | 22,320,000 | 886,000 | 441,000 |
| 1974-75 | 397,000 | 23,820,000 | 946,000 | 473,000 |
| 1975-76 | 421,000 | 25,260,000 | 1,002,000 | 501,000 |
| 1976-77 | 440,000 | 26,400,000 | 1,048,000 | 524,000 |
| 1977-78 | 459,000 | 27,540,000 | 1,094,000 | 547,000 |
| 1978-79 | 478,000 | 28,680,000 | 1,138,000 | 569,000 |
| 1979-80 | 497,000 | 29,820,000 | 1,184,000 | 592,000 |
| TOTALS | | | | |
| FY 66-67 thru 74-75 | 2,169,000 | $130,140,000 | $ 4,993,000 | $2,406,000 |
| FY 75-76 thru 79-80 | 2,295,000 | $137,700,000 | $ 5,466,000 | $2,733,000 |
| FY 66-67 thru 79-80 | 4,464,000 | $267,840,000 | $10,459,000 | $5,139,000 |

Advantages in using general funds for bikeways include:

1. Appropriating sales tax revenues from the general fund would provide bicyclists with a direct return on the money they have paid into the general fund.

2. Having a long-term source of funding provided, monies are appropriated each biennium.

3. No interest charge is payable.

4. A broad cross section of the public shares in the financing of bikeways.

5. General funds represent a prime source of funding for municipalities and counties to participate in the development of bikeways.

6. Funds could be established for the Commission of Outdoor Recreation to

fund recreational bikeways.

Disadvantages in using general funds to finance bikeways include:

1. General fund appropriations for bikeways would have to compete with other programs each biennium to obtain funding.

2. Sufficient monies may not be available in the general fund to finance recreational bikeways. For example, if $78,307,000 were expended between fiscal years 1975-76 and 1979-80 to develop 4,560 miles of bikeways, the average annual expenditure would be $15,661,000 per year.

3. In an inflationary economy, limited financial appropriations could lengthen the period of time to construct the necessary facilities and thereby increase the overall cost of the bikeways.

The use of general funds to finance the development of bikeways merits serious consideration in view of the sales tax payments by purchasers of bicycles, the increasing popularity of bicycling and the current practice of using general funds to finance certain other transportation programs. A minimum appropriation might be $547,000 per fiscal year based on sales tax payments paid by bicyclists into the general fund. A maximum appropriation might be $15,661,000 per fiscal year between 1975-76 and 1979-80, which would allow development of 4,560 miles of bikeways.

Revenue Sharing Funds

Federal revenue sharing funds as established by the State and Local Fiscal Assistance Act of 1972, more commonly known as Revenue Sharing, might be used for a variety of expenditures, including:

1. Ordinary and necessary maintenance and operating expenses for public transportation, including transit systems and streets and roads.

2. Ordinary and necessary capital expenditures. (Correspondence from the Office of Revenue Sharing in Washington, D. C. indicated that revenue sharing monies can be used by the state or local units of government to design, construct or maintain bikeways)

The State and Local Fiscal Assistance Act of 1972 covers seven entitlement periods running from January, 1972, through December, 1976. The federal revenue sharing funds that might be distributed to the state and local units of govern-

ment in the Commonwealth on a fiscal year basis are tabulated in Table 13.

TABLE 13
COMMONWEALTH OF VIRGINIA
DISTRIBUTION OF FEDERAL REVENUE SHARING FUNDS TO STATE & LOCAL GOVERNMENTS

| | State Government | | Local Governments | |
|---|---|---|---|---|
| Fiscal Year | Federal Revenue Sharing Fund | Federal Revenue Sharing Fund Interest | Federal Revenue Sharing Fund | Total |
| 1972-73 | $ 44,148,950 | $1,026,640 | $ 88,297,900 | $133,473,490 |
| 1973-74 | 39,870,740 | 3,000,000 | 79,741,480 | 122,612,220 |
| 1974-75 | 40,300,000 | 1,000,000 | 80,600,000 | 121,900,000 |
| 1975-76 | 41,000,000 | 1,100,000 | 82,000,000 | 124,100,000 |
| 1976-77 | 32,900,000 | 855,400 | 65,800,000 | 99,555,400 |
| Total | $198,219,690 | $6,982,040 | $396,439,380 | $601,641,110 |
| Average Per Fiscal Year | $ 39,643,938 | $1,396,408 | $ 79,287,876 | $120,328,222 |

With the State and Local Fiscal Assistance Act of 1972 expiring after December, 1976, revenue sharing funds will not be available to supplement the state's general fund unless the Act is extended by new federal legislation.

General Obligation Bonds

If general obligation bonds were used to finance bikeways, several Constitutional requirements must be satisfied.

1. The size of an individual debt when added to the debts issued during the three previous years cannot exceed 25 percent of 1.15 times the average annual tax derived from taxes on income and retail sales.

2. The total aggregate debt cannot exceed 1.15 times the average annual tax derived from taxes on income and retail sales.

3. Full faith and credit obligations of the Commonwealth are required to be approved by the General Assembly and the voters of Virginia in a statewide bond referendum.

Using tax data from fiscal years 1971, 1972 and 1973, the Commonwealth's debt ceiling as of June 30, 1973, could not exceed $205,988,978 for a single

bond issue or $820,395,591 for all outstanding bond issues.

The Commission of Outdoor Recreation proposed to issue an $84,000,000 bond issue to finance the Virginia Outdoors Plan. If this bond issue, which failed to reach the floor of the 1974 Legislature for a vote, is reconsidered and passed at a later date, the state's total indebtedness of January 1, 1974, would increase from $290,300,000 to $374,300,000. With no other bonds issued, the Commonwealth's total indebtedness would be $446,095,091 less than the legal ceiling. Thus, there is considerable financial latitude in satisfying the state's Constitutional debt requirements if general obligation bonds were used for bikeways.

Assuming general obligation bonds were issued for a twenty year period with 5 percent interest, the costs would be as depicted in Table 14.

TABLE 14
ESTIMATED COST OF GENERAL OBLIGATION BONDS FOR BIKEWAYS

| Bond Issue | Annual Principal Plus Interest Charges | Total Principal Plus Interest Charges |
|---|---|---|
| $ 1,000,000 | $80,243 Per Year | $1,604,860 |
| $78,307,000 | $6,284,000 Per Year | $125,680,000 |

Benefits in using general obligation bonds for the development include:

1. A direct indication of citizen and voter interest is attained through a referendum.
2. With bond monies in a separate trust fund, competition with other capital improvement programs for monetary grants is eliminated and prospects of completing the bikeway program are enhanced.
3. With sufficient monetary resources available, construction contracts can be awarded sooner, thereby combating inflationary trends in the economy.
4. Interest charges of a general obligation bond might be offset by investigating the unused portions of the bond issue in various securities as enumerated in Section 2.1-327 of the Virginia Code.

Disadvantages in using general obligation bonds to finance bikeways include:

1. The payment of the principal and interest represents a fixed annual appropriation from the general funds.

2. General obligation bonds would not provide a hedge against inflation if construction prices were to decrease or stabilize at their present level.

3. Payment of principal and interest on the bonds would be against those citizens' desires who did not support issuance of the bonds in the referendum.

Other considerations associated with the sale of general obligation bonds include:

1. The issuance of this type of bond to exclusively finance bikeways would set a precedent. In most instances, bond issues for highway facilities are repaid with toll fees collected from highway users. By comparison, a general obligation bond issue for bikeways would have to be repaid with revenues from the general fund rather than with toll fees collected from bikeway users.

2. Legislation and a simple majority of the voters approving the project in a referendum are required if a general obligation bond issue for bikeway is to be used.

If general obligation bonds are considered to finance bikeways, the state's resent indebtedness, the principal and interest charges, the benefits, the iabilities and other considerations should be thoroughly evaluated before proeeding with this financial alternative.

icycle Excise Tax

One method to assess bicycle users for the development of bikeways would be o levy a statewide excise tax on all new bicycle sales. If either a 5 or 10 ercent excise tax is levied and the average sale price of a new bicycle is ssumed to be $60, revenues would be generated as depicted in Table 15.

TABLE 15
COMMONWEALTH OF VIRGINIA
GROSS REVENUES FROM 5 AND 10 PERCENT BICYCLE EXCISE TAX

| Fiscal Year | Gross Revenue From 5% Excise Tax | Gross Revenue From 10% Excise Tax |
|---|---|---|
| 1975-76 | $1,263,000 | $ 2,526,000 |
| 1976-77 | 1,320,000 | 2,640,000 |
| 1977-78 | 1,377,000 | 2,754,000 |
| 1978-79 | 1,434,000 | 2,868,000 |
| 1979-80 | 1,491,000 | 2,982,000 |
| Total | $6,885,000 | $1 3,770,000 |
| Average | $1,377,000 | $ 2,754,000 |

Advantages in using a bicyde excise tax are:

1. This exclusive form of taxation could create a special monetary account for the development of bikeways.

2. The purchaser of a new bicycle would be paying directly for the bikeway system he would be utilizing.

Disadvantages associated with a bicycle excise tax are:

1. A double form of taxation would exist unless the 4 percent sales tax were repealed.

2. The problems in collecting a special excise tax on a special line of merchandise may be difficult and in all probability not feasible.

3. Only new bicycle owners would participate financially in the development of bikeways and those citizens who already owned bicycles and used the same transportation facilities would be excluded.

4. Revenues would be dependent on bicycle sales and fluctuate in relation thereto. Thus, if sales were down, the ability to establish new bikeways or maintain existing ones might be restricted.

Bicycle Registration and Licensing

Most registration-licensing programs have been established to assist in the recovery of stolen bicycles and to discourage bicycle theft. However, with the increasing demand for bikeway systems, the establishment of adequate registration-licensing fees to provide monies for the development of bikeways merits

consideration.

Frequently, nominal fees, which cover only a portion of the administrative expenses, are charged to register and license bicycles, with the deficit financed out of a municipality's or county's general fund. Thus, a compulsory statewide registration-licensing fee wherein the bicyclist would pay directly for the establishment of bikeways should be evaluated.

In evaluating the collection of bicycle registration-licensing fees, the number of bicycles that might be registered in the Commonwealth is estimated by:

1. Assuming 10 percent of the total bicycle population is comprised of small bicycles and tricycles which would not be subject to compulsory registration-licensing statutes.

2. Assuming 10 percent of the remaining bicycles would not be registered in accordance with provisions of a compulsory state law.

Utilizing these assumptions, the number of bicycles that would be registered in Virginia is tabulated in Table 16.

TABLE 16
COMMONWEALTH OF VIRGINIA
PROJECTED NUMBER OF BICYCLES IN USE AND
BICYCLES REGISTERED AND LICENSED

| Fiscal Year | Projected Number Bicycles in Use | Projected Number Bicycles Registered and Licensed |
|---|---|---|
| 1975-76 | 1,768,000 | 1,432,000 |
| 1976-77 | 1,904,000 | 1,542,000 |
| 1977-78 | 2,045,000 | 1,657,000 |
| 1978 79 | 2,196,000 | 1,779,000 |
| 1979-80 | 2,354,000 | 1,907,000 |
| Total | 10,267,000 | 8,317,000 |

The Virginia Division of Motor Vehicles estimates that an administrative cost of $2.08 per vehicle was incurred to register and license automobiles from July 1, 1972 through June 30, 1973. If the cost to register automobiles and

bicycles is assumed to be equal, total administrative costs for bicycles are estimated to be $17,300,000 from fiscal year 1975-76 through 1979-80.

If an annual compulsory statewide registration-licensing fee of $4 is established, $15,968,000 in net revenue is produced as shown in Table 17.

TABLE 17
COMMONWEALTH OF VIRGINIA
REVENUES COLLECTED FROM A COMPULSORY
$4.00 BICYCLE REGISTRATION-LICENSING FEE

| Fiscal Year | Number Licensed Bicycles | Gross Revenues | Administrative Cost | Net Revenue |
|---|---|---|---|---|
| 1975-76 | 1,432,000 | $ 5,728,000 | $ 2,979,000 | $ 2,749,000 |
| 1976-77 | 1,542,000 | 6,168,000 | 3,207,000 | 2,961,000 |
| 1977-78 | 1,657,000 | 6,628,000 | 3,447,000 | 3,181,000 |
| 1978-79 | 1,779,000 | 7,116,000 | 3,700,000 | 3,416,000 |
| 1979-80 | 1,907,000 | 7,628,000 | 3,967,000 | 3,661,000 |
| Total | 8,317,000 | $33,268,000 | $17,300,000 | $15,968,000 |

Similarily, if an annual compulsory statewide registration-licensing fee of $5 is established, $24,285,000 in net revenues is produced as shown in Table 18.

TABLE 18
COMMONWEALTH OF VIRGINIA
REVENUES COLLECTED FROM A COMPULSORY
$5.00 BICYCLE REGISTRATION-LICENSING FEE

| Fiscal Year | Number Licensed Bicycles | Gross Revenues | Administrative Cost | Net Revenue |
|---|---|---|---|---|
| 1975-76 | 1,432,000 | $ 7,160,000 | $ 2,979,000 | $ 4,181,000 |
| 1976-77 | 1,542,000 | 7,710,000 | 3,207,000 | 4,503,000 |
| 1977-78 | 1,657,000 | 8,285,000 | 3,447,000 | 4,838,000 |
| 1978-79 | 1,779,000 | 8,895,000 | 3,700,000 | 5,195,000 |
| 1979-80 | 1,907,000 | 9,535,000 | 3,967,000 | 5,568,000 |
| Total | 8,317,000 | $41,585,000 | $17,300,000 | $24,285,000 |

To some bicyclists, it may appear exorbitant to pay a compulsory fee of $5 per year to register and license a bicycle. However, with Virginians paying an

average of 1.67 cents per mile in road user taxes, the tax which motorists and bicyclists would pay on a per-mile basis would be equal when a bicyclist traveled 323 miles per year, and proportionately lower for every mile the bicyclist traveled beyond this break-even distance. Furthermore, using annual mileage rates from bicycle reports published for the State of Arizona and the Cities of Riverside, California and Raleigh, North Carolina, an average unit price of 0.883 cents per mile is attained with the $5 registration-licensing fee. Thus, it is apparent that the average cost per mile to register and license a bike for $5 compares favorably with the 1.67 cents per mile paid by the average highway user in road user taxes.

Another comparison is to analyze the daily costs associated with fishing and bicycling. Dividing the $5 cost of a resident fishing license by the average participation rate of 5.6 activity-days per year produces a unit cost of 89.3 cents per activity-day. Similarly, dividing a $5 bicycle registration-licensing fee by 21.25 activity days, as published in the Commission of Outdoor Recreation's Demand Survey", produced an average cost of 23.5 cents per day. Thus, with the cost of a bicycle license 73.7 percent less than a fishing license on an activity-day basis, the collection of a $5 registration-licensing fee seems reasonable and equitable.

Besides generating funds for bicycle facilities, other benefits derived from a registration-licensing system include:

1. A means to assist in the recovery of stolen bicycles.
2. The opportunity to inspect bicycles for safe operating condition
3. An expeditious method to identify the bicycle or owner, particularly in emergencies or for the issuance of bicycle violation notices.
4. A means to recall defective bicycle equipment by manufacturers.
5. A possible planning tool to aid in the disbursement of bikeway monies in the Commonwealth.

Disadvantages with a compulsory registration-licensing program include:

1. A significant percentage of the revenues would be used for administrative expenses.

2. Bicyclists may become reluctant to abide by a compulsory registration-licensing ordinance, particularly if they don't see bikeway facilities developed in their areas.

3. Payment of a compulsory registration-licensing fee may pose an economic burden on some households with several bicycles to register.

The Commonwealth's existing statutes may not allow an authority to register and license bicycles on a statewide basis. Thus, new statutes may have to be enacted before a state agency would have the authority to register and license bicycles.

Combination of Funding Sources

When evaluating a combination of funding sources for bikeways, it is pertinent to review the revenues that may be produced by various finance alternatives. For fiscal years 1975-76 through 1979-80, these sums are tabulated in Table 19.

TABLE 19
COMMONWEALTH OF VIRGINIA
SUMMARY OF ESTIMATED REVENUES
PRODUCED BY VARIOUS BIKEWAY FUNDING ALTERNATIVES
(FISCAL YEAR 1975-76 THRU 1979-80)

| 'unding Alternative | Estimated Revenue |
|---|---|
| Highway Funds | Funded on an Individual Project Basis |
| lotor Fuel Tax | |
| .. Increase Existing Gas Tax ½¢ Per Gallon | $34,653,000 |
| . Increase Existing Gas Tax ½¢ Per Gallon | $69,306,000 |
| 'eneral Fund | |
| .. Minimum Appropriation | $ 2,733,000 |
| . Maximum Appropriation (Based on revenues deposited into state's general fund from existing sales tax on bicycles) | $78,307,000 (1) |
| evenue Sharing Funds Deposited into state's general fund) | $78,307,000 (1) |
| eneral Obligation Bonds | $78,307,000 (1) |
| icycle Excise Tax | |
| . Five Percent Excise Tax (Average Tax $3 Per Bicycle) | $ 6,885,000 |
| . Ten Percent Excise Tax (Average Tax $6 Per Bicycle) | $13,770,000 |
| lcycle Registration and Licensing Fund | |
| . Net Revenue from $4 Annual Compulsory Fee Per Bicycle | $15,968,000 |
| . Net Revenue from $5 Annual Compulsory Fee Per Bicycle | $24,285,000 |

l) Overall cost, using 1972 construction prices, to satisfy 1980 demand for 4,560 miles of bikeways.

A combination of funding sources might be considered to produce funds for ›propriate commuter and recreational bikeways. Considering that commuter bike- ıys already can be constructed by the Department of Highways and Transportation ı a part of a highway construction project, funds to support recreational bike- ıys will be needed. As an example, a minimum general fund appropriation and

a $5 bicycle registration-licensing fee produces $27,018,000 as tabulated in Table 20.

TABLE 20
COMMONWEALTH OF VIRGINIA
REVENUES PRODUCED BY A COMBINATION OF FUNDING SOURCES
(MINIMUM GENERAL FUND APPROPRIATION PLUS
$5.00 ANNUAL COMPULSORY BICYCLE REGISTRATION-LICENSING FEE)

| Funding Source | 1975-76 | 1976-77 | 1977-78 | 1978-79 | 1979-80 | Total |
|---|---|---|---|---|---|---|
| | | | (1,000's) | | | |
| General Fund: (Minimum Appropriation) | $ 501 | $ 524 | $ 547 | $ 569 | $ 592 | $ 2,733 |
| Bicycle Registration and Licensing Fund: (Net revenue derived from a $5 annual compulsory fee per bicycle) | 4,181 | 4,503 | 4,838 | 5,195 | 5,568 | 24,285 |
| Total | $4,682 | $5,027 | $5,385 | $5,764 | $6,160 | $27,018 |

Advantages in using this combination of funding sources for recreational bikeways include:

1. More revenues are generated than would normally be available from one source.

2. Sole dependence on one source of revenue is eliminated thereby enhancing the financial stability of the bikeway program.

3. The tax-paying public and the bicyclist, all beneficiaries of a bikeway program, participate in the development of the facilities.

Disadvantages in using this combination of funding sources include:

1. General funds for bikeways would be in competition with requested appropriations for other programs and may not be approved.

2. A $5 bicycle registration fee may create an economic burden on some households.

Some reasons for not including other financial alternatives for bikeways in the combination of funding sources are as follows:

1. With gas tax increased 2.0 cents per gallon on July 1, 1972 to finance highway improvements, it did not seem proper to impose another fuel tax

increase on the public for bikeways at this time.

2. The Department of Highways and Transportation is already funding locally-approved commuter bikeways.

3. Since revenue sharing funds are a monetary supplement to the state's general fund, it seems more appropriate to consider the use of general funds.

4. Interest expenses could be avoided by not issuing general obligation bonds.

5. With a bicycle excise tax, a double form of taxation would exist (unless the present sales tax were repealed); the collection of revenues would pose complex problems; and the assessment of such a tax would not cover all bicyclists.

Several reasons why a combined source of funding should not be minimized include:

1. This financial alternative commences satisfying a portion of the desire for bikeway facilities.

2. This type of funding annually reduces the difference between the bikeway facilities which are desired and those which are in service.

3. This financial alternative will ultimately satisfy the demand for bikeway facilities provided the projected mileage demand for bikeways is accurately forecasted.

With a combination of funding sources producing $27,018,000 in revenues for recreational bikeways from 1975-76 through 1979-80 or an average of $5,403,600 per fiscal year, the advantages, disadvantages and other consequences associated with this financial alternative merit serious consideration.

# Conclusions
# And
# Recommendations

## CONCLUSIONS AND RECOMMENDATIONS

This report provides information regarding bikeway activities in the Commonwealth of Virginia based upon data received from the Virginia Commission of Outdoor Recreation and from the Virginia Department of Highways and Transportation. The Department of Highways and Transportation has investigated bikeway activities throughout the Commonwealth and in several instances, is constructing bikeway projects. It is immediately concluded that the differentiation between recreational and commuter bikeway activities must be established in order to appropriately spend the public funds to provide necessary and justified bikeway facilities.

The Department of Highways and Transportation is already involved in commuter bikeway facilities and has established guidelines relating to the financing of bikeway facilities as a part of highway projects. It is important to note that the Department of Highways and Transportation has no authority to expend funds upon bikeways which are generally recreational in nature and would require an independent right-of way, such as a bicycle trail. Considering this point, this report recommends that a bikeway fund be developed and that the Virginia Commission of Outdoor Recreation or other appropriate agency be given the authority to utilize local participation in the construction of recreational bikeways. This would include all such types of recreational bicycle facilities which cannot be funded by the Virginia Department of Highways and Transportation.

As a result, two state agencies may be involved in the bikeway development program. It does not appear appropriate at this time for the Department of Highways and Transportation to have the responsibility of funding recreational projects, such as bikeways for recreational purposes, unless additional legislation providing for this type of fund administration and construction authority

is enacted.

The Commission of Outdoor Recreation is certainly concerned with bikeways, particularly in state parks and other similar facilities. At the same time, the Department of Highways and Transportation is working with local governments to review local bikeway plans for adequate, safe and justifiable routings. In all urban areas over 50,000 population throughout the State of Virginia, the bikeway planning activities are being accomplished as a part of the continuing, cooperative, comprehensive transportation process required by federal law. Accordingly, bicycle plans are being incorporated into the overall transportation scheme on a regional level in each of these major metropolitan areas. These bikeway plans are also being prepared in these areas as a result of the emphasis on the transportation control strategies being promulgated by the Environmental Protection Agency, and it is anticipated that these plans will be utilized to support any requirement that EPA may enforce relative to the provision of bikeways as an alternative to reduce automobile usage.

In all respects, the planning of bikeways is a matter of local initiative and certainly should be undertaken by local governments where interest requires action. In this manner, local participation and arrangements for annual maintenance can be considered by local officials and all appropriate costs aggregated as projects begin to take shape.

House Joint Resolution 224, which requested this study, has asked specific questions regarding the bikeway activities. These questions are directly answered as follows:

1. A statewide system of bicycle trails is not recommended at this time due to the physical problems of establishing bicycle routes and the complexity of identifying bicycle facilities on a statewide basis. However, local and regional bikeway systems are much more important and do relate directly to the average length of trip by bicycle. Consequently, even though a statewide system is not recommended, all local governments are encouraged to develop bikeways on a local and regional basis in order to satisfy the demands within each geographic area.

2. It is not desirable to divert a specific portion of highway funds to meet bikeway requirements. The Department of Highways and Transportation is already utilizing highway funds to construct bikeways on a project-by-project basis as an integral part of highway construction or improvement projects. This policy will certainly continue and will be expanded as local bikeway facilities are developed and requests for inclusion of bikeway facilities in specific highway construction and improvements are made to the Department of Highways and Transportation. At the same time, the Department of Highways and Transportation is directly related to commuter bicycle routes and is encouraging commuter bicycle routes on projects where appropriate. However, funding for recreational bikeways has not been established and these facilities also need to be considered by the General Assembly.

   As a result of this study, it is recommended that a Virginia Bikeway Fund for recreational bikeway facilities be established and that the administration of this fund be vested in an agency dealing with recreational activities, such as the Commission of Outdoor Recreation. This should be utilized specifically for recreational bikeways and should require some local matching funds in order to assure appropriate operation and control of the facilities. Commuter bicycle routes should continue to be financed by the Department of Highways and Transportation as a portion of the individual project utilizing highway funds.

There are a number of specific individual recommendations which relate to the development of bikeway activities in the Commonwealth. These are listed in the Appendix for information purposes. Generally, recommendations of this report are directed toward the establishment of a bikeway fund and the authority to administer such a fund in an existing state agency. Additional bikeway activities and legislative suggestions are related to operational responsibilities, bicycle safety and administration of funds.

The listing of objectives and recommendations in the Appendix is provided as a guide for full review of the problems involving the development of bikeways. The general conclusion of this report is that commuter bikeways can be handled under present arrangements; however, recreational bikeways will require funding and authorization in areas, such as right-of-way acquisition, authority to construct, etc. This report, its recommendations and suggestions, is submitted to fulfill the requirements of House Joint Resolution 224 and is directed

to serve only for general information and as a guide to the Legislature in considering the problems of the development of bikeways in the Commonwealth of Virginia.

# Appendix

# APPENDIX

The information presented in this study clearly establishes the feasibility for bikeways in the Commonwealth of Virginia on a local and regional basis. It is appropriate to proceed with the development of a bikeway program by establishing objectives supplemented with recommendations.

The creation of specific objectives establishes a series of focal points which might be utilized to suggest the development of bikeways in the Commonwealth. The recommendations represent specific courses of action, which, if implemented, provide a means to satisfy the objectives. The ensuing sections present objectives and recommendations dealing with: Funding of Bikeways; Planning, Design and Construction of Bikeways; Operational Responsibilities for Bikeways; and Bicycle Safety.

## FUNDING OF BIKEWAYS

Funding is of paramount importance in the development of any transportation facility. With limited budgets, and rising costs of materials and labor, municipal and county governments, as well as state agencies, have severe constraints in funding the development of capital facilities and providing operational revenues. Accordingly, a Virginia Bikeway Development Fund could be established as a trust fund, with legislation enacted by the General Assembly, and thereby provide a means to finance the development of recreational bikeway facilities in the state. In conjunction with the funding of bikeways, the following objectives and recommendations are presented.

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| . To establish the sources of revenue that might comprise a Bikeway Development Fund for the Commonwealth of Virginia. | 1A. The funding section of the bikeway report discussed the status of existing programs administered by state and federal agencies that might be used to fund bikeways and discussed the possible use of new bikeway funding programs that might be administered by agencies of the state government. It is recommended the General Assembly review these financial programs and enact legislation to implement the use of a "Combination of Funding" sources. |
| | 1B. To supplement bikeway revenues raised at the state levels, the agency administering the Virginia Bikeway Development Fund should be charged by the State Legislature to solicit additional bikeway funds from existing and new federal programs enacted by Congress. |
| To merge the available sources of revenue for the establishment of a Virginia Bikeway Development Fund. | 2A. Legislation should be enacted by the General Assembly to assign one state agency the sole responsibility to administer the Virginia |

| OBJECTIVES | RECOMMENDATIONS |
| --- | --- |
| | Bikeway Development Fund. Since this fund is to be established for recreational bikeway facilities, the program should be developed and administered by the Virginia Commission of Outdoor Recreation. This agency would then approve plans for local, regional and state recreational bikeway facilities for implementation by local, regional agencies and the Division of State Parks. |
| | 2B. Legislation should be enacted by the General Assembly wherein more than one agency might deposit collected revenues into the Virginia Bikeway Development Fund. The authorized agency for registration and licensing might deposit revenues collected from a registration-licensing fee and a general fund appropriation might be deposited directly into the trust fund account from the Commonwealth's General Fund. |
| | 2C. Legislation should be enacted wherein any unprogrammed funds in the Virginia Bikeway Development Fund might be deposited in various securities to provide additional revenues. This interest from the investment of unprogrammed funds should be directed to the Virginia Bikeway Development Fund. |
| 3. To develop a distribution procedure for the allocation of revenues from the Virginia Bikeway Development Fund throughout the Commonwealth. | 3A. To insure that bicyclists throughout the Commonwealth have the opportunity to see and utilize bikeway facilities developed in their regions, the state agency administering the Virginia Bikeway Development Fund should devise and utilize a formula for the distribution of bikeway funds into each area under its jurisdiction. Factors utilized initially in the |

| OBJECTIVES | RECOMMENDATIONS |
| --- | --- |
| | distribution of bikeway funds might include: population; area; bicycles registered and licensed; and bikeway needs. |
| | 3B. Bikeway funds assigned to each area should be distributed within the area on the basis of local plans and relative need without regard to jurisdictional boundaries. |
| To develop a matching grant-in-aid program for the development of bicycle facilities. | 4A. To insure local commitment to bikeway projects and spread financial support to more agencies of municipal, county and state government, the state agency administrating the Virginia Bikeway Development Fund should develop cost participation policies concerning the development of bicycle facilities. |
| To establish a list tabulating the items which might be fully or partially funded from the Virginia Bikeway Development Fund. | 5A. Monies from the Virginia Bikeway Development Fund may be expended on the following items:<br>(a) The costs of grading, drainage, paving, barriers, landscaping and structures necessary to accommodate the number and type of users of the facility.<br>(b) The cost of supplementary facilities such as parking facilities, bicycle storage facilities, comfort stations.<br>(c) The costs of traffic control devices such as signs and pavement markings.<br>(d) The cost of fixed-source lighting when its use is warranted.<br>(e) The costs of curb-cut ramps on new and existing facilities.<br>(f) The cost of walks, barriers and additional widths on bridges when necessary for bikeways and pedestrian walkways. |

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| | (g) The cost of bikeway grade separations when justified. |
| | (h) The cost of right-of-way when not publicly owned and not possible to acquire through other means. |

## PLANNING, DESIGN AND CONSTRUCTION OF BIKEWAYS

Prior sections of this report presented information with regards to: bicycle sales; bicycles in use; the feasibility of establishing bikeways; and the demand mileage for bikeways. Based on this information, it is deemed appropriate to proceed with the development of bikeways. To facilitate the planning, design and construction of bikeways in the Commonwealth, the following objectives and recommendations should be implemented.

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| 1. To initially develop local and urban bikeway facilities for recreational and commuting purposes in local communities and designated recreational areas. | 1A. In planning, designing and constructing local and urban bikeway systems for commuters and recreational users, the routes should be selected by the appropriate local officials so as to serve the interests of the community. |
| | 1B. To facilitate the planning of bikeways among citizens at the grass roots level, local officials should form committees represented by planners, engineers, school officials, park and recreation representatives, officials from civic organizations and members of bicycling clubs. Their designated responsibilities would be to: determine desired routings of bikeways; review possible locations of bi- |

| OBJECTIVES | RECOMMENDATIONS |
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| | cycle facilities as enumerated in the body of this report; establish priorities for the development of bikeways within their jurisdictions. |
| | 1C. A proposed bikeway plan must be approved by the local unit of government and the state agency designated to administer the Virginia Bikeway Development Fund prior to the use of monies from this fund to construct any bicycle facilities. |
| To develop regional bikeway facilities connecting existing local and urban bikeway systems. | 2A. State, county and city agencies, working with the planning, design or construction of bikeways, should fully cooperate with and assist regional and local planning authorities as part of a continuing transportation planning process. |
| | 2B. As plans for local and urban bikeway systems are developed, highway corridors and other locations should be reviewed to evaluate their ability to accommodate bicyclists. |
| | 2C. In the planning and design of roadways, consideration should be given to the need for bikeways when applicable. |
| To thoroughly evaluate safety considerations in the location, design and construction of bikeways. | 3A. To minimize the possibility of accidents between bicyclists and motorists or bicyclists and pedestrians, bikeway warrants, as enumerated in the report, should be utilized to initially select the appropriate type of bikeway facility (bicycle trail, bicycle lane or shared roadway). If bicycle volumes, vehicular traffic volumes or speed limits are subject to significant change in the not too distant future, extreme care should be utilized in selecting the appropriate facility to mini- |

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| | mize the risk of bicycle-vehicular collisions. |
| | 3B. In developing shared roadways, bicycle lanes or bicycle trails, the suggested bikeway layouts and design criteria enumerated in the body of this report should be utilized where feasible to provide uniformity and safety for bicyclists who will use these facilities in various areas within the Commonwealth. |
| | 3C. In selecting the location of bikeway facilities, officials of municipalities, counties or other jurisdictions should strive to develop comprehensive bikeway plans which provide contiguous routes and minimize conflicts between vehicular and bicycle traffic. |

## OPERATIONAL RESPONSIBILITIES FOR BIKEWAYS

In addition to the planning, design and construction of bikeways, operational responsibilities are an important consideration in relation to bicycle facilities. The following objectives and recommendations should be implemented with regards to the operation of bicycle facilities in the Commonwealth of Virginia.

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| 1. Operational responsibilities, related to maintenance and enforcement activities, etc., for bikeways, should be established. | 1A. Cities and towns having operational responsibilities on their street systems, should fulfill similar responsibilities for bikeways located within existing highway rights-of-way. |
| | 1B. Counties having operational re- |

sponsibilities on Secondary Roads should fulfill these responsibilities for bikeways located within existing highway rights-of-way.

1C. The federal government, when fulfilling operational responsibilities on roads under its jurisdiction, should also fulfill these responsibilities for bikeways located within existing highway rights-of-way.

1D. The state, when fulfilling operational responsibilities on roads under its jurisdiction, should also fulfill these responsibilities for bikeways located within existing highway rights-of-way.

1E. Cities, towns or counties financing the construction of bikeways outside highway rights-of-way should assume the operational responsibilities for these bicycle facilities.

1F. Private firms or private individuals financing the construction of bikeways outside highway rights-of-way should assume the operational responsibilities for these bicycle facilities.

1G. Federal agencies financing the construction of bikeways outside high way rights-of-way should assume the operational responsibilities for these bicycle facilities.

## BICYCLE SAFETY

Three basic elements involved with the safe operation of any transportation ıtem are engineering, education and enforcement. The field of engineering is ʻolved with the creation of bikeways; the field of education provides informa-

tion relative to this mode of transportation; and the field of enforcement is involved with the compliance of traffic ordinances.

An analysis of bicycle-motor vehicle accidents in a previous section of this report revealed that a high percentage involved young people between 5 and 19 years of age and that approximately three-fourths of all the accidents were attributable to the bicycle operator.

A comprehensive bicycle safety program must be implemented to correct this situation. To be meaningful and have a positive influence in reducing bicycle-motor vehicle accidents, the program should include the following items:

1. Bicycle safety
2. Public information endeavors
3. Regulation of bicycling activities
4. Registration and licensing of bicycles
5. Enforcement of ordinances related to bicycling
6. Appropriate legal sanctions against lawbreakers

The following objectives and recommendations should be implemented as part of a comprehensive bicycle safety program in the Commonwealth covering all areas of bicycling:

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| 1. To improve bicycle ordinances at the state and local levels of government and make them enforceable and meaningful. | 1A. Officials from state, county and municipal governments should thoroughly review the provisions related to bicycling as contained in the Uniform Vehicle Code published by the National Committee on Uniform Traffic Laws and Ordinances. |
| | 1B. Officials from state, county and municipal governments through legislative action should: |
| | (a) Enact bicycle ordinances |

| OBJECTIVES | RECOMMENDATIONS |
|---|---|
| | which are in conformance with the Uniform Vehicle Code when deemed feasible.<br><br>(b) Delete existing bicycle ordinances which are neither enforceable or enforced and are not considered pertinent to the safety of bicyclists, motorists or pedestrians. |
| To enforce state, county and municipal laws relative to bicycling and thereby improve safety. | 2A. Enforcement agencies of the state, county and local governments should be encouraged to give proper consideration to bicycle law enforcement as a part of their jurisdictions' total law enforcement program. This can be accomplished by making laws and ordinances related to bicycling enforceable and realistic, as recommended in the previous section of this report. |
| To familiarize all bicyclists and motor vehicle operators with the rules of the road as they relate to bicycling. | 3A. To satisfy this objective the General Assembly should enact a resolution calling for the establishment of bicycle safety education programs for juveniles and adults.<br><br>3B. Juvenile traffic safety programs with emphasis on bicycles should be conducted from the kindergarten through junior high school at regularly scheduled intervals throughout the state's public and private school systems.<br><br>3C. Adult traffic safety programs, with curriculum on bicycling, should be conducted in:<br><br>(a) Driver education courses for high school students.<br><br>(b) Driver education courses taught by private firms or individuals. |

| OBJECTIVES | RECOMMENDATIONS |
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| | (c) Traffic court classrooms for traffic offenders. |
| | 3D. To keep adult motorists informed of bicycle safety rules, regulations and the correct usage of bikeway systems, the various news media should be used. |
| 4. To increase public awareness and support for a comprehensive bicycle safety program. | 4A. The state agency administrating the Virginia Bikeway Development Fund should publish a pamphlet or brochure describing the development and utilization of bikeways in Virginia and distribute it to officials in municipalities, counties and other state agencies and federal agencies throughout the Commonwealth. These officials can then disburse the pamphlets or brochures to individual citizens, bicycle dealers and groups with whom they come into contact. |
| | 4B. Short bicycle safety announcements should be broadcast on television and radio stations inasmuch as these communication media are required to provide public service announcements to retain their Federal Communication Commission licenses. |
| | 4C. Newspapers should be utilized to publish pictures and stories related to bicycle safety programs. |
| | 4D. Films describing the development and safe usage of bicycle facilities should be produced and made available to schools, legislature groups, chambers of commerce committees, cycling clubs, societies and other civic organizations for their use. |
| | 4E. Speakers, well informed with the subject of bicycling, should be utilized to make presentations at schools and other civic organiza- |

| OBJECTIVES | RECOMMENDATIONS |
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| | tion meetings to stress the importance of bicycle safety. |

# HOUSE JOINT RESOLUTION NO. 224

*Directing the Department of Highways to conduct a study on the feasibility of establishing a system of bicycle trails throughout the Commonwealth.*

Offered January 22, 1973

Patrons—Messrs. Coleman and Giesen

Referred to the Committee on Roads and Internal Navigation

Whereas, dependence on motorized transportation and the resulting lack of opportunity for recreation and exploration in the outdoors are major factors in contributing to the determination of the quality of our life; and

Whereas, the bicycle is one answer to mounting traffic jams and resulting air pollution and more and more people are taking up bicycling for commuting as well as for recreational purposes; and

Whereas, now highways are increasingly built with limited access and new suburbs often permit builders to skip the expense of sidewalks even on local streets; as a result walking becomes difficult and riding a bicycle is positively dangerous; and

Whereas, it seems desirable that some consideration should be given to the establishment of special roadways for bicycles; now, therefore, be it

Resolved by the House of Delegates, the Senate of Virginia concurring, That the Department of Highways is directed to conduct a study on the feasibility of establishing a system of bicycle trails throughout the Commonwealth, to include the consideration of diverting a portion of the highway funds for this purpose or other means of financing.

In conducting this study the Department shall seek the opinions of governing bodies of counties and cities throughout the Commonwealth. All agencies of the Commonwealth and of its political subdivisions shall assist in this study upon request.

The Department shall complete its study and submit its recommendations to the Governor and the General Assembly not later than October one, nineteen hundred seventy-four.

# Bibliography

## BIBLIOGRAPHY


1. Alder, A. L. and E. B. Roessler. Introduction to Probability & Statistics. W. H. Freeman & Company, San Francisco, California, 1964.

2. Airis, T. F. Director, Department of Highways and Traffic, Washington, D. C. Private correspondence dated April 13, 1973.

3. American Association of State Highway Officials. A Policy on Geometric Design of Rural Highways. Washington, D. C., 1966.

4. American Association of State Highway and Transportation Officials. Guide for Bicycle Routes. Washington, D. C., 1974.

5. American Automobile Association. "Planning Criteria for Bikeways." Falls Church, Virginia, 1973.

6. American Institute of Park Executives. Bike Trails and Facilities: A Guide to their Design, Construction and Operation. Oglebay Park, Wheeling, West Virginia, May, 1965.

7. Andrews, Basil. "Design For Bicycles." Traffic Engineering, August, 1972.

8. Ashby, Deborah H. "Pedaling Path-Ways" (Sunday supplement magazine to Washington Post Newspaper). Washington, D. C., July 29, 1973.

9. Barron, John S. Tennessee Valley Authority, Knoxville, Tennessee. Private correspondence dated February 1, 1974 concerning bikeways and the Tennessee Valley Region Water Resources Development program.

10. Barton-Aschman Associates, Inc. "The Bicycle - A Plan And Program For Its Use As A Mode Of Transportation And Recreation - Atlanta Metropolitan Region." St. Paul, Minnesota, July, 1973.

11. Barton Aschman Associates, Inc. "The Bicycle - A Plan And Program For Its Use As A Mode of Transportation And Recreation (Technical Appendix) - Atlanta Metropolitan Region." St. Paul, Minnesota, July, 1973.

12. Bicycle Institute of America. "Bicycle Safety Tests And Proficiency Course." New York City, New York, undated.

13. Bicycle Institute of America. "Bicycle Trail Legislation - Proposed and Enacted Bills." New York City, New York, April, 1972.

14. Bicycle Institute of America. "Bicycle Trail Legislation - Trail Funding-Regulation-Studies." New York City, New York, undated.

15. Bicycle Institute of America. "Boom in Bikeways," Vol. 8, No. 1. New York City, New York, March, 1973.

16. Bicycle Institute of America. "New Directions in Bicycle Safety," Vol. 4, No. 1. New York City, New York, March, 1974.

17. Bicycle Institute of America. "Pedal Power - Courses of Action For Commuter Bike Routes." New York City, New York, undated.

18. Bicycle Institute of America. "Some Facts About The 'New Golden Age of The Bicycle'." New York City, New York, October 15, 1973.

19. "Bike Boom: A Wayout For Commuters?" U.S. News & World Report, December 6, 1971.

20. Birnbaum, Marie. U.S. Department of Transportation, Washington, D. C. Private correspondence with enclosed bicycle articles received August 29, 1973.

21. Bivens & Associates, Inc., Planning Consultants. "Arizona Bikeways Program." Phoenix, Arizona, June 15, 1973.

22. Bivens, John A. Bivens & Associates, Inc., Planning Consultants, Phoenix, Arizona. Private correspondence dated March 25, 1974.

23. California, State of. Bikeway Planning Criteria And Guidelines. Institute of Transportation & Traffic Engineering, University of California at Los Angeles, UCLA-ENG-7224, April, 1972.

24. California, State of. "Highway Project Development - Provisions for Pedestrians, Equestrians, Bicycles and Light Motorcycles." Department of Public Works, Division of Highways, Sacramento, September 20, 1972.

25. Campbell, Earl M. "The Energy Outlook for Transportation in the United States." American Highways, Vol. 52, No. 3. July, 1973.

26. Carstens, Victor P. Carstens Products, Inc., Toledo, Ohio. Private correspondence dated December 26, 1973.

27. Cascade Bicycle Club. "Washington State Bicycle Routes Plan - 1973 Recommendations." Olympic, Washington, 1973.

28. Cleckner, Robert M. "Bikeways on Highways - Facts - Figures - Reasons." Bicycle Institute of America, New York City, New York, undated.

29. Cleckner, Robert M. "New Switches On Old Abandoned Railroads." Bicycle Institute of America, New York City, New York, undated.

30. Cleckner, Robert M. "The Long Look At Bicycle Safety." Bicycle Institute of America, New York City, New York, undated.

31. Cleckner, Robert M. "The Nuts and Bolts of a Bikeway." Bicycle Institute of America, New York City, New York, undated.

32. Cleckner, Robert M. "The Path of Least Resistance." Bicycle Institute

of America, New York City, New York, undated.

33. Colorado, State of. "Report of the Colorado Recreational Trails Committee." Denver, Colorado, 1973.

34. Cooper, H. H. Engineer of Traffic & Safety, Michigan Department of Highways and Transportation, Lansing, Michigan. Private correspondence dated April 18, 1973.

35. Coxe, Andrew S. Office of the Secretary of the Treasury, Office of Revenue Sharing, Washington, D. C. Private correspondence dated January 14, 1974 concerning bikeways and the "State and Local Fiscal Assistance Act of 1972."

36. Cryderman, S. F. Engineer of Transportation Planning, Michigan Department of Highways and Transportation, Lansing, Michigan. Private correspondence dated September 21, 1973.

37. Currey, Lynn H. Office of the Governor, Commonwealth of Virginia, Richmond, Virginia. Private correspondence dated February 12, 1974 concerning bikeways and the Appalachian Regional Development Act.

38. Davey, William B. United States Department of Agriculture, Soil Conservation Service, Washington, D. C. Private correspondence dated December 13, 1973 concerning bikeways and the Watershed Protection and Flood Prevention Program.

39. Deleuw, Cather & Company. "City of Davis, University of California - Bicycle Circulation and Safety Study." San Francisco, California, August 31, 1972.

40. Denver, City of. "The Bikeway Plan." Denver, Colorado, Planning Office, 1972.

41. Dickerson, L. A. United States Department of Agriculture, Farmers Home Administration, Washington, D. C. Private correspondence dated December 5, 1973 concerning bikeways and the Recreation Loans, Resource Conservation and Development Loans and Watershed Protection and Flood Prevention Loans.

42. Dougherty, N. "The Bicycle vs. The Energy Crisis." Bicycling Magazine, January, 1974.

43. Durham, L. A., Jr. Norfolk and Western Railway Company, Roanoke, Virginia. Private correspondence dated February 28, 1974.

44. Everrett, Michael. University of Southern Mississippi, Hattiesburg, Mississippi. Private correspondence dated December 11, 1973.

45. Fairfax County Park Authority - Park Planning Division. "Trail System Study." Fairfax County, Virginia, 1972.

46. Florida, State of. "Bicycle Trails and Footpaths Report" (Including Attachments A, B, C & D). Florida Department of Transportation,

February, 1973.

47. Foley, J. P. and D. N. Levine, E. A. Pascarella and J. R. Stewart, Jr. "Characteristics of Youthful Riders In An Urban Community And Events Accruing To Operation Of Their Vehicles." The University of North Carolina Highway Safety Research Center, Chapel Hill, North Carolina, June, 1971.

48. Foley, James L. United States Department of Transportation, Federal Highway Administration, Office of Highway Safety, Washington, D. C. Private correspondence dated December 12, 1973, concerning bikeways and the State and Community Highway Safety Program.

49. Gallagher, J. A. Traffic Engineer, Washington State Department of Highways, Olympia, Washington. Private correspondence dated April 25, 1973.

50. Galler, Sol. "Federal Aid For Transportation." Better Roads, September, 1973, pp. 20 & 25.

51. Green, W. R. Chief - Project Development Branch, California Department of Transportation (Division of Highways), Sacramento, California. Private correspondence dated September 21, 1973.

52. Harbridge House, Inc. "Harbridge House National Bikeway Survey." Boston, Massachusetts, May, 1974.

53. Hawaii, State of. "An Approach To Establishing Bikeways." Department of Transportation, Highways Division (Highway Planning Branch), December, 1970.

54. Hayes, J. "Some Facts About The Current Bike Explosion." Bicycle Institute of America, New York City, New York, August 11, 1972.

55. "Here Come The Bikeways." Sunset, October, 1972.

56. Hibbard, Thomas H. (Willamette University), and Fred Miller (Oregon Department of Transportation). "Applications of Benefit Cost Analysis: The Selection of Non-Construction Projects." Salem, Oregon. Paper presented at 53rd Highway Research Board Meeting, Washington, D. C., January 22, 1974.

57. Hicks, Cary R. and Trent Germano, Paul H. Sanders and Paul H. Wright. "The Emerging Needs of Bicycle Transportation." Highway Research Board Record, No. 436, 1973.

58. Highway Users Federation. "1973 Highway Transportation Legislation." Washington, D. C., 1973.

59. "Honolulu's Bicycle Safety Program." Public Works, East Stroudsburg, Pennsylvania, January, 1974.

60. Hughes, Jack D. Winchester and Western Railroad Company, Winchester, Virginia. Private correspondence dated February 13, 1974.

61. Hunter, E. S. "Oregon's Experience With Bicycle Routes." Oregon State Highway Division, Salem, Oregon. Paper presented at Annual Meeting of American Association of State Highway Officials, Denver, Colorado, July 19, 20 & 21, 1972.

62. Institute of Traffic Engineers. Traffic Engineering Handbook, Third Edition, Washington, D. C., 1965.

63. International City Management Association. "Planning and Development of Bikeway Systems." Management Information Service Report, Vol. 5, No. 4. Washington, D. C., April 7, 1973.

64. J. H. K. and Associates. "Bicycle Facilities Safety & Location Criteria" (A proposal submitted to the U.S. Department of Transportation). Alexandria, Virginia, March 12, 1973.

65. Jones, J. S. and D. C. Woo. "Hydraulic Characteristics of Two Bicycle-Safe Grates" (A Preliminary Report). Environmental Design & Control Division, Offices of Research and Development, Federal Highway Administration, Washington, D. C., 1973.

66. Lewis, John W. "Illinois Bicycle Rules of the Road." Secretary of State, Springfield, Illinois, March, 1972.

67. Linkous, D. T. Virginia Division of Motor Vehicles, Richmond, Virginia. Private correspondence dated January 10, 1974 regarding administrative costs to register and license automobiles and maintain automobile title certificates.

68. Long, Luman H. The World Almanac and Book of Facts, 1971 Edition. Newspaper Enterprise Association, Inc., New York City, New York, 1971.

69. Maryland, State of. "Statewide Bikeway Study." Maryland Department of Transportation, Annapolis, Maryland, May, 1973.

70. Mason, Carroll A. Department of Housing And Urban Development, Washington, D. C. Private correspondence dated February 7, 1974 concerning bikeways and the Community Development Program.

71. McCoy, J. L. Virginia Division of Motor Vehicles, Richmond, Virginia. Private correspondence dated May 17, 1974.

72. McSwine, Edward, (University of Tennessee). "Biking In Knoxville: An Inter-City Hike-Bike Trail And Bikeway Along First Creek and Woodbine Avenue." Knoxville, Tennessee, Bureau of Recreation and Office of Tributary Area Development, Tennessee Valley Authority, October, 1972.

73. Metropolitan Washington Council of Governments. "Planning for the Bicycle as a Form of Transportation: A Manual for Local Communities." Washington, D. C., November, 1973.

74. Miami Valley Regional Planning Commission. "Miami Valley Regional Bike-

way Plan (Technical Supplement)." Dayton, Ohio, 1973.

75. Miller, Fred. "Benefits of Bicycle Route Construction." Oregon State Highway Division, Salem, Oregon, 1972.

76. Montana, State of. "Suggested Policy And Guidelines For Bike Trails and Footpaths." Montana Department of Highways, November, 1972.

77. Nagushi, Joseph. "The Urban Bicycle Route System for the City of Palo Alto, California." Bicycle Institute of America, New York City, New York, undated.

78. New Jersey, State of. "Bikeways For State Highways - A Study of Dual Use." New Jersey Department of Transportation - Division of Transportation and Planning Research, Trenton, New Jersey, 1973.

79. New York, State of. "Bikeways In New York State." Department of Transportation, Albany, New York, October, 1973.

80. Norman, City of. "Bicycle Paths." Staff report published by City of Norman, Oklahoma, May 1, 1972.

81. "Opening Wedges Into Toronto." Landscape Architecture, October, 1972.

82. Oregon, State of. "Bikeway Design." Oregon State Highway Division, Salem, Oregon, January, 1974.

83. Oregon, State of. "Footpaths & Bike Routes Standards And Guidelines." Oregon State Highway Division, Salem, Oregon, January, 1972.

84. Oregon, State of. "Oregon Bikeways Progress Synopsis." Oregon Department of Transportation, Highway Division, Salem, Oregon, 1972.

85. Podolske, Richard C. "Investing In Urban Bicycle Facilities: How Much? What Type? Where?" Barton-Aschman Associates, Inc., St. Paul, Minnesota. Paper presented at "Bicycles U.S.A." Conference in Cambridge, Massachusetts on May 7, 1973.

86. Portland, City of. "Preliminary Study of Bicycle Facilities For The City of Portland." Portland, Oregon, October 29, 1971.

87. Reinfurt, W. D. Staff Associate, The University of North Carolina Highway Safety Research Center, Chapel Hill, North Carolina. Private correspondence dated March 19, 1974.

88. Richmond, City of. "Feasibility Study For Bikeways In Richmond." Richmond, Virginia, November, 1973.

89. Riverside, City of. "Riverside Pedestrian/Bicycle Safety Program." Riverside, California. JHK & Associates, San Francisco, California, May, 1972.

90. "Shop Talk." Bicycling Magazine, December, 1972, pp. 36.

91. Stark, P. M. Seaboard Coast Line Railroad Company, Jacksonville, Florida. Private correspondence dated January 28, 1974.

92. Stein, Jefferey, "How To Get Your Bike On Mass Transit." Bicycling Magazine, November, 1973, pp. 42.

93. Stockard, Don and April. "Bike Law: Our Rights & Reason - Legislation 1974." Bicycling Magazine, June, 1974.

94. "10 Little Bike Riders." Brochure distributed by Virginia Highway Safety Division, Richmond, Virginia, and produced by Imagination, Inc., 2651 University Avenue, Saint Paul, Minnesota, 55114.

95. Thomas, Ralph E. United States Department of the Interior, National Park Service, Washington, D. C. Private correspondence dated November 23, 1974 concerning bikeways and the "Historic Preservation Grants-in-Aid Program."

96. Transportation Section. Government Executive Magazine, Washington, D. C., September, 1973.

97. Underhill, A. Heaton. United States Department of the Interior, Bureau of Outdoor Recreation, Washington, D. C. Private correspondence dated January 24, 1974 concerning bikeways and the Land and Water Conservation Fund.

98. United States Government. Department of Commerce. 1969 Statistical Abstract of the United States. Washington, D. C., 1969.

99. United States Government. Department of Commerce. 1972 Statistical Abstract of the United States. Washington, D. C., 1972.

100. United States Government. Department of Commerce. 1973 Statistical Abstract of the United States. Washington, D. C., 1973.

101. United States Government. Department of the Interior, Bureau of Outdoor Recreation. "Establishing Trails on Rights-of-Way." Washington, D. C., 1972.

102. United States Government. Department of the Interior, Bureau of Outdoor Recreation. "The 1970 Survey of Outdoor Recreation Activities - Preliminary Report." Washington, D. C., February, 1972.

103. United States Government. Department of the Interior, Bureau of Outdoor Recreation. "Trails For America - Report On the Nationwide Trail Study." Washington, D. C., December, 1966.

104. United States Government. Department of the Interior, Office of Library Services. "Bicycling and Bicycle Trails - A Trails and Trail Based Activities Bibliography." Washington, D. C., June, 1971.

105. United States Government. Department of the Interior and Agriculture, Bureau of Outdoor Recreation. "National Scenic & Recreational

Trails." Washington, D. C., March, 1970.

106. United States Government. Department of Justice, Federal Bureau of Investigation. "Uniform Crime Reports 1971 - Crime in the United States." Washington, D. C., August 12, 1972.

107. United States Government. Department of Transportation, Federal Highway Administration. "Bicycle Routes Along or Crossing Federal Aid Highways" (Policy & Procedures Memorandum 21-23). Washington, D. C., March 14, 1973.

108. United States Government. Department of Transportation, Federal Highway Administration. "Bikeways and Pedestrian Walkways in Conjunction with Federal and Federal Aid Highways" (Transmittal 18, Federal Aid Highway Program Manual). Washington, D. C., March 8, 1974.

109. United States Government. Department of Transportation, Federal Highway Administration. "Urban Transportation Planning" (Transmittal 29, Federal Aid Highway Program Manual). Washington, D. C., May 23, 1974.

110. United States Government. Department of Transportation, Federal Highway Administration. "Federal Laws, Regulations and Material Relating to the Federal Highway Administration." Washington, D. C., 1971.

111. United States Government. Department of Transportation, Federal Highway Administration. "Highway Statistics - 1971." Washington, D. C., October, 1973.

112. United States Government. Department of Transportation, Federal Highway Administration. Manual on Uniform Traffic Control Devices For Streets and Highways. Washington, D. C., 1971.

113. United States Government. Department of Transportation. "Transportation Energy Conservation Options." Cambridge, Massachusetts, 1973.

114. United States Government. Ninety-third Congress. "Federal Aid Highway Act of 1973" (Report No. 93-355). Washington, D. C., July, 1973.

115. United States Government. Office of Management & Budget. "1973 Catalog of Federal Domestic Assistance." Washington, D. C., June, 1973 and November, 1973 editions.

116. United States Government. "Title 31 - Chapter 24 - Fiscal Assistance To State And Local Governments." United States Code - 1970 Edition-Supplement II. United States Government Printing Office, Washington, D. C., 1973.

117. Virginia Code Commission. "Chapter 17 - Public Debt." 1973 Supplement - Code of Virginia. The Michie Company, Charlottesville, Virginia, May, 1973.

118. Virginia Code Commission. "Chapter 18 - Investment of Public Funds." 1973 Supplement - Code of Virginia. The Michie Company, Charlottes-

ville, Virginia, May, 1973.

119. Virginia Code Commission. "Chapter 23 - Virginia Security For Public Deposits Act." 1973 Supplement - Code of Virginia. The Michie Company, Charlottesville, Virginia, May, 1973.

120. Virginia Code Commission. "Chapter 81 Virginia Retail Sales and Use Tax." 1973 Supplement - Code of Virginia. The Michie Company, Charlottesville, Virginia, May, 1973.

121. Virginia Code Commission. "Constitution of Virginia - 1971." 1973 Replacement Volume - Code of Virginia. The Michie Company, Charlottesville, Virginia, January, 1973.

122. Virginia, Commonwealth of. Commission of Outdoor Recreation. "General Obligation Bond Issue to Finance the Virginia Outdoors Plan." Richmond, Virginia. Position paper dated October 1, 1973.

123. Virginia, Commonwealth of. Commission of Outdoor Recreation. "The Virginia Outdoors Plan, 1970" (Volumes I, II, III & IV). Richmond, Virginia, May, 1970.

124. Virginia, Commonwealth of. Commission of Outdoor Recreation. "Virginia Outdoor Recreation Demand Survey." Richmond, Virginia, May, 1973.

125. Virginia, Commonwealth of. Commission of Outdoor Recreation. "Virginia Outdoors." Special Issue dated November 2, 1973. Richmond, Virginia.

126. Virginia, Commonwealth of. Commission of Outdoor Recreation. "Virginia Outdoors," Vol. 4, No. 4. Richmond, Virginia, October, 1973.

127. Virginia, Commonwealth of. Division of the Budget. "Analysis of Appropriations and Revenues 1968-70 Biennium." Richmond, Virginia, July, 1968.

128. Virginia, Commonwealth of. Division of the Budget. "Analysis of Appropriations and Revenues - 1970-72 Biennium." Richmond, Virginia, July, 1970.

129. Virginia, Commonwealth of. Division of the Budget. "Analysis of Appropriations and Revenues - 1972-74 Biennium." Richmond, Virginia, July, 1972.

130. Virginia, Commonwealth of. Division of Motor Vehicles, Richmond, Virginia. Written correspondence concerning conference meetings on May 1 and May 13, 1974.

131. Virginia Department of Highways and Transportation (Division of Traffic & Safety). "Population of Counties, Cities And Incorporated Towns - 1970 Census." Richmond, Virginia, September, 1971.

132. Virginia, Commonwealth of. Highway Safety Division. "Bicycling in Virginia Laws & Safety Rules" (4 page brochure). Richmond, Virginia,

April, 1973.

133. Virginia, Commonwealth of. "House Bill No. 30" (A bill to appropriate the public revenue between July 1, 1974 and June 30, 1976). Richmond, Virginia, February 25, 1974.

134. Virginia, Commonwealth of. "House Joint Resolution No. 224 Directing the Department of Highways to conduct a study on the feasibility of establishing a system of bicycle trails throughout the Commonwealth." Richmond, Virginia, January 22, 1973.

135. Virginia, Commonwealth of. "Joint Conference Committee Report on House Bill 30" (A bill to appropriate the public revenue between July 1, 1974 and June 30, 1976). Richmond, Virginia, March 8, 1974.

136. Virginia Department of Highways and Transportation. "Virginia's Roads And Streets 1972-82" (A study for the Virginia Advisory Legislative Council). Richmond, Virginia, December, 1971.

137. Virginia's Planning & Community Affairs Division and Virginia's Department of Taxation. "Fiscal Prospects And Alternatives: 1974" (A staff report to the Commonwealth's Revenue Resources and Economic Study Commission). Richmond, Virginia, June, 1973.

138. Virginia, University of. Bureau of Population and Economic Research. "Selected Housing Characteristics of Virginia - 1980." Charlottesville, Virginia, August, 1971.

139. Virginia, University of. Bureau of Population and Economic Research. "Selected Population Characteristics of Virginia - 1970." Charlottesville, Virginia, August, 1971.

140. Washington Area Bicycle Association. "Ride On," Special edition. Washington, D. C., June, 1974.

141. Washington Area Bicycle Association. "Ride On," Vol. II. No. 2, Washington, D. C., 1973.

142. Washington Area Bicycle Association. "Ride On," Vol. III, No. 1. Washington, D. C., January - February, 1974.

143. Washington Area Bicycle Association. "Ride On," Vol. III, No. 3. Washington, D. C., May - June, 1974.

144. Wolfe, Frederick L. "Exclusive Bike Lane Operating Experience on Denver Streets." Denver Regional Council of Government. Paper presented at Highway Research Board's 53rd Annual Meeting, Washington, D. C., January, 1974.

145. Younger, Evelle J. "Automated Stolen Bicycle System - Evaluation Progress Report." California Department of Justice, Sacramento, California, February 1, 1974.