CHAPTER 4. NEEDS ANALYSIS

4.1. INTRODUCTION

This chapter presents an overview of the needs of bicyclists in the Miami Valley. Adequately identifying user needs enables system planners and policy-makers to develop logical solutions for improving the region's bikeway network. The chapter first describes general bicyclist types and their associated needs, followed by demand analysis providing an overview of areas in the Miami Valley where cyclists are likely to be riding, with estimates of existing and future demand. The text also estimates potential benefits of an improved regional bikeway network with respect to air quality and public health. A bicycle/pedestrian collision data analysis follows, highlighting non-motorized crash trends and problem areas. The chapter concludes with results from a user survey.

4.2. NEEDS AND TYPES OF BICYCLISTS

It is important to understand that the needs and preferences of bicyclists vary depending on the skill level of the cyclist and the type of trip the cyclist is taking. For example, bicyclists who bicycle for recreational purposes may prefer scenic, winding, off-street trails, while bicyclists who ride to work or for errands may prefer more direct on-street bicycle facilities. Child bicyclists, seniors, and adults new to bicycling may prefer shared use paths, while adult bicyclists with many years of experience may prefer bicycle lanes. Cyclists also include utilitarian cyclists who choose to live with one less car, and people who ride because they have no other transportation option due to economic reasons. A bicycle plan should consider these differences when planning a system that serves all user types. The following sections describe the different types of bicyclists, the different reasons for bicycling, and the respective needs of these categories of bicyclists.

4.2.1. Needs of Casual and Experienced Riders

For the purposes of this Plan, bicyclists are separated into two skill levels: casual and experienced. Casual bicyclists include youth, adults and seniors who are intermittent riders (see Figure 25). Some casual bicyclists, such as youths under driving age, may be unfamiliar with operating a vehicle on roads and related laws. Experienced bicyclists include commuters, long-distance road bicyclists, racers, and those who use their bicycle as a primary means of transportation. Table 1 summarizes the needs of casual and experienced bicyclists.

Table 1. Characteristics of Casual and Experienced Bicyclists

Casual Riders	Experienced Riders
Prefer off-street shared use paths or bike lanes along low-volume, low-speed streets	Prefer on-street or bicycle-only facilities as opposed to shared use paths
May have difficulty gauging traffic and may be unfamiliar with rules of the road. May walk bike across intersections	Comfortable riding with vehicles on streets. Negotiates streets like a motor vehicle, including "taking the lane" and using left-turn pockets
May use less direct route to avoid Arterials with heavy traffic volumes	May prefer a more direct route
May ride on sidewalks and ride the wrong way on streets and sidewalks	Avoids riding on sidewalks or on shared use paths. Rides with the flow of traffic on streets
May ride at speeds comparable to walking, or slightly faster than walking	Rides at speeds up to 20 MPH on flat ground, up to 40 mph on steep descents
Bicycle for shorter distances: up to 2 miles	May cycle longer distances, sometimes more than 100 miles

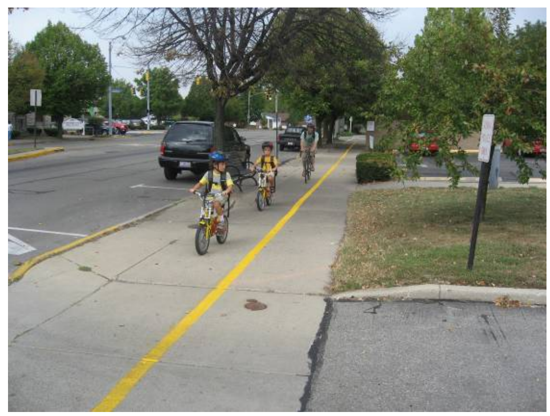

Figure 25. Children bicycling in Xenia

The casual bicyclist will benefit from route markers, shared use paths, bike lanes on lower-volume streets, traffic calming, and educational programs. Casual bicyclists may also benefit from a connected network of marked routes leading to parks, schools, shopping areas, and other destinations. To encourage youth to ride, routes must be safe enough for their parents to allow them to ride. The experienced bicyclist will benefit from a connected network of bike lanes on higher-volume arterials, wider curb lanes and loop detectors at signals. The experienced bicyclist who is primarily interested in exercise will benefit from loop routes leading back to their point of origin. Because of its extensive network of shared use paths, the Miami Valley region offers many opportunities for casual bicyclists. Several of these paths are accessible from residential neighborhoods (e.g., in Xenia). Many experienced bicyclists, including those who bicycle longer distances to commute for exercise or training, also use the region's path system. This combination of fast-moving bicyclists on training rides with slower-moving casual bicyclists and pedestrians may result in user conflicts.

4.2.2. Characteristics of Recreational and Utilitarian Trips

For purposes of this Plan, bicycle trips are separated into two trip types: recreational and utilitarian. Recreational trips can range from a 50-mile weekend group ride along rural roads to a family outing along the Great Miami River Recreation Trail, and all levels in between (see Figure 26). Utilitarian trips include commuter bicyclists, which are a primary focus of State and Federal bicycle funding, as well as bicyclists going to school, shopping or running other errands. Utilitarian cyclists include those who choose to live with one less car, as well as those who have no other alternative transportation due to economic reasons. Table 2 summarizes general characteristics of recreational and utilitarian bicycle trips.

Table 2. Characteristics of Recreational and Utilitarian Bicycle Trips

Recreational Trips	Utilitarian Trips
Directness of route not as important as visual interest, shade, protection from wind	Directness of route and connected, continuous facilities more important than visual interest, etc.
Loop trips may be preferred to backtracking	Trips generally travel from residential to shopping or work areas and back
Trips may range from under a mile to over 50 miles	Trips generally are 1-5 miles in length
Short-term bicycle parking should be provided at recreational sites, parks, trailheads and other activity centers	Short-term and long-term bicycle parking should be provided at stores, transit stations, schools, workplaces
Varied topography may be desired, depending on the skill level of the cyclist	Flat topography is desired
May be riding in a group	Often ride alone
May drive with their bicycles to the starting point of a ride	Use bicycle as primary transportation mode for the trip; may transfer to public transportation; may or may not have access to a car for the trip
Trips typically occur on the weekend or on weekdays before morning commute hours or after evening commute hours	Trips typically occur during morning and evening commute hours (commute to school and work). Shopping trips also occur on weekends
Type of facility varies, depending on the skill level of the cyclist	Generally use on-street facilities, may use trails if they provide easier access to destinations than on-street facilities

Recreational bicyclists' needs vary depending on their skill level. Road bicyclists out for a 100-mile weekend ride may prefer well-maintained roads with wide shoulders and few intersections, and few stop signs or stop lights. Casual bicyclists out for a family trip may prefer a quiet shared use path with adjacent parks, benches, and water fountains.

Figure 26. Recreational bicyclists in Xenia.

Utilitarian bicyclists have needs that are more straightforward. Key commuter needs are summarized below:

- Commuter routes should be direct, continuous, and connected
- Protected intersection crossing locations are needed for safe and efficient bicycle commuting
- Bicycle commuters must have secure places to store their bicycles at their destinations
- Bicycle facilities should be provided on Arterial streets

The Miami Valley's trail system provides excellent access several parks, recreation areas, and the downtown cores of several communities. However, not all neighborhoods have easy bicycle access to employment centers, schools and shopping. For the casual recreational rider, this may not be a serious deterrent, since they would be willing and able to drive their bicycle to the trailhead. However, this may not be an option for the experienced recreational rider or the commuter, as they generally would like to use their bicycle for the whole trip. Bicycle-friendly on-street connections between residential areas and the trails and between residential areas and shopping and commute centers would likely increase the prevalence of bicycle commuting, as well as increase the prevalence of recreational riding.

4.3. DEMAND ANALYSIS

This section uses a variety of demand models to estimate usage of the Miami Valley's existing bicycle facilities, and to estimate the potential usage of new facilities. The purpose of these models is to provide an overview of the demand and benefits for bicycling and walking in the region. As with all models, the results show a range of accuracy that can vary based on various assumptions and available data. The models used for this Plan incorporate information from existing publications as well as data from the U.S. Census. All data assumptions and sources are noted in the tables following each section of the analysis.

Bicycle demand and activity centers were used 1) to ensure that the region-wide network including bicycle facilities serving high-demand and high-activity-level areas and 2) to prioritize implementation of bikeway improvements.

4.3.1. Existing Bicycling Demand

The Miami Valley bicycle demand model consists of several variables including commuting patterns of working adults, and predicted travel behaviors of area college students and school children. For modeling purposes, the study area included all residents within Greene, Miami, Montgomery, and Northern Warren counties in 2005. The information was ultimately aggregated to estimate the total existing demand for bicycle facilities in the region. Table 3 identifies the variables used in the model. Data regarding the existing labor force (including number of workers and percentage of bicycle commuters) was obtained from the 2000 U.S. Census and 2005 American Community Survey. It should be noted that complete 2005 American Community Survey data sets is not available for the entire study area, therefore 2000 U.S. Census Data was largely used for this analysis.

Table 3. Journey-to-Work Characteristics

Variable	Greene County	Miami County	Montgomery County	Carlisle	Franklin	Springboro
Total	72,958	49,799	259,419	2,527	5,173	6,045
Car, truck, or van	67,638	47,030	239,378	2,429	5,026	5,706
Drive alone	61,601	43,042	217,161	2,091	4,367	5,287
Carpooled	6,037	3,988	22,217	338	659	419
Public transportation	194	267	6,935	0	10	12
Bus or trolley bus	102	180	6,778	0	10	12
Streetcar or trolley car	7	0	19	0	0	0
Subway or elevated	18	0	32	0	0	0
Railroad	0	0	0	0	0	0
Ferry boat	4	0	10	0	0	0
Taxicab	63	87	96	0	0	0
Motorcycle	22	26	147	0	0	0
Bicycle	177	54	377	0	0	15
Walked	2,590	788	5,746	30	63	41

Variable	Greene County	Miami County	Montgomery County	Carlisle	Franklin	Springboro
Other means	240	278	1,117	23	11	33
Worked at home	2,097	1,356	5,719	45	63	238

Source: U.S. Census, 2000.

In addition to people commuting to the workplace via bicycle, the model also incorporates a portion of the labor force working from home. Specifically, it was assumed that about half of those working from home would make at least one bicycling or walking trip during the workday. The 2000 U.S. Census was also used to estimate the number of children in the Miami Valley. This figure was combined with data from National Safe Routes to School surveys to estimate the proportion of children riding bicycles to and from school. College students constitute a third variable in the model due to the presence of a number of colleges and universities in the region. Data from the Federal Highway Administration regarding bicycle mode share in university communities was used to estimate the number of students bicycling to and from these campuses. Finally, data regarding non-commute trips was obtained from the 2001 National Household Transportation Survey to estimate bicycle trips not associated with traveling to and from school or work. Journey-to-work data trends (as shown in Table 4 below) highlight decreases in the total number of trips outside of private vehicles from 1990-2000. While journey-to-work data for 2005 is incomplete for the Miami Valley region, the statewide averages are slightly higher than those seen for the Miami Valley between 1990 and 2000 primarily due to shifts in the percent of those employed working at home.

Table 4. 1990-2005 Journey-to-Work Trends

Miami Valley Region[1]	Journey-to-Work Trends[2]		
Means of transportation to work	2005	2000	1990
Bicycle	1.0%	0.6%	0.6%
Walked	1.9%	2.3%	2.6%
Worked at home	3.0%	2.4%	2.1%
Transit	1.7%	1.9%	2.2%
Total trips not in private vehicles	7.6%	7.2%	7.5%

Source: U.S. Census, 1990-2005.

1 Includes Greene, Miami, Montgomery, and Northern Warren counties.

2 Estimate based on American Community Survey (2005) values for the State of Ohio.

Table 5 summarizes estimated existing daily bicycle trips in the Miami Valley. The table indicates that over 79,000 trips are made on a daily basis. Most bicycle commuting trips are made by college students as well as persons making trips while working from home. School children make the fewest daily bicycle trips. The model also shows that non-commuting trips comprise the vast majority of existing bicycle demand.

Table 5. Aggregate Estimate of Existing Daily Bicycling Activity in the Miami Valley

Variable	Figure	Calculations
Employed Adults, 16 Years and Older		
a. Study Area Population (1)	862,526	
b. Employed Persons (2)	409,186	
c. Bicycle Commute Mode Share (2)	0.2%	
d. Bicycle Commuters	818	(b*c)

Variable	Figure	Calculations
e. Work-at-Home Percentage (2)	2.4%	
f. Work-at-Home Bicycle Commuters (3)	4,822	[(b*e)/2]
School Children		
g. Population, ages 6-14 (4)	56,633	
h. Estimated School Bicycle Commute Mode Share (5)	2%	
i. School Bicycle Commuters	1,133	(g*h)
College Students		
j. Full-Time College Students (6)	39,022	
k. Bicycle Commute Mode Share (7)	10%	
l. College Bicycle Commuters	3,902	(j*k)
Work and School Commute Trips Sub-Total		
m. Daily Bicycle Commuters Sub-Total	10,675	(d+f+i+l)
n. Daily Bicycle Commute Trips Sub-Total	21,350	(m*2)
Other Utilitarian and Discretionary Trips		
o. Ratio of "Other" Trips in Relation to Commute Trips (8)	2.73	ratio
p. Estimated Non-Commute Trips	58,286	(n*o)
Total Estimated Daily Bicycle Trips	79,636	(n+p)

Notes:

Census data collected from 2000 U.S. Census, American Community Survey, Miami Valley Region, Ohio.

(1) 2000 U.S. Census, STF3, P1.

(2) 2000 U.S. Census, S0801.

(3) Assumes 50% of population working at home makes at least 1 daily bicycle trip.

(4) 2000 U.S. Census, S0101.

(5) Estimated share of school children who commute by bicycle, as of 2000 (source: National Safe Routes to School Surveys, 2003).

(6) Fall 2004 full-time enrollment National Center for Education Statistics (University of Dayton, Wright State University, Antioch University, Central State University, Wilberforce University, Cedarville, Wittenburg, and Edison State University).

(7) Review of bicycle commute mode share in 7 university communities (source: National Bicycling & Walking Study, FHWA, Case Study #1, 1995).

(8) 27% of all trips are commute trips (source: National Household Transportation Survey, 2001).

4.3.2. Geographic Distribution of Demand

The Project Team also examined the geographic distribution of bicycle demand. Two maps were generated: Map 4-1: Existing and Potential Bicycling Demand, which uses Census data to indicate locations that have populations that are likely to bike, and Map 4-2: Cycle Density Attractors, indicating the location of destinations that are likely to attract bicyclists.

Table 6 identifies the variables used in developing the bicycle demand map. The Project Team used data to estimate population density (population per census block group), household density (number of dwelling units per acre), and socio-economic factors that may affect bicycle ridership (density of college students and density of zero-car households, percentage of commute trips under nine minutes, percentage of people who bike to work). In developing the Attractors map, regional land use data was used and weighted by trip percentages based on information provided by MVRPC. Table 7 summarizes the factors and weights used for developing the Cycle Density Attractors Map.

Table 6. Determining Geographic Location of Bicyclists and Potential Bicyclists

Factor	Source	Calculation	Rational for Calculation	Weighting
Estimated number of bicycles from households with no vehicles (block group)	2000 U.S. Census	Number of no-vehicle Households *10%* Average people per HH	"About 10% of households that don't own a motorized vehicle make bike trips in a given day, compared to 4% of vehicle-owning households." (from University of Minnesota fact page[1])	3
Housing units per acre (block group)	2000 U.S. Census	0 to 5 HH/acre = -5 5.1 to 9.9 HH/acre = 0 10 to 13.9 HH/acre = 5 points 14 to 28 HH/acre=10 points	Walking rates only start to increase at residential densities over 14 HH/acre	2
Estimated number of people with commute under nine minutes that convert to bicycling (block group)	2000 U.S. Census	number of people * 0.1	9 minute car ride at 32 MPH (national average per NHTS) is equal to 4.6-mile bike ride (assuming 10% can be captured to bike)	1
Estimated number of adults who bicycle every day (block group)	2000 U.S. Census	Population over 18 *(0.3% + 1.5*bicycle commute mode share)	Based on formula derived from University of Minnesota Study (Barnes & Krizek)	4

1 http://www.hhh.umn.edu/centers/slp/bike_basicfacts.html) accessed July 8, 2007.

Table 7. Factors Used to Calculate Destination Density

Attractor Type	Weight
Open Space	0.20
Large Retail Center	0.20
Retail Center	0.10
Major Employer	0.30
Transit Hub	0.20

Major bicycle trip generators exist through the Miami Valley. Major regional employers include Wright Patterson Air Force Base, hospital campuses (e.g. Miami Valley Hospital, Greene Memorial Hospital, and Sycamore Hospital), as well as local and regional government agencies. The Miami Valley region is also home to several educational institutions, including Antioch University, Central State University, Clark State University, Edison State University, Sinclair Community College, University of Dayton, Wilberforce University, and Wright State University. The region is perhaps best known for its vast parks and recreation facilities, notably John Bryan State Park, Sycamore State Park, Cox Arboretum, and MetroParks facilities.

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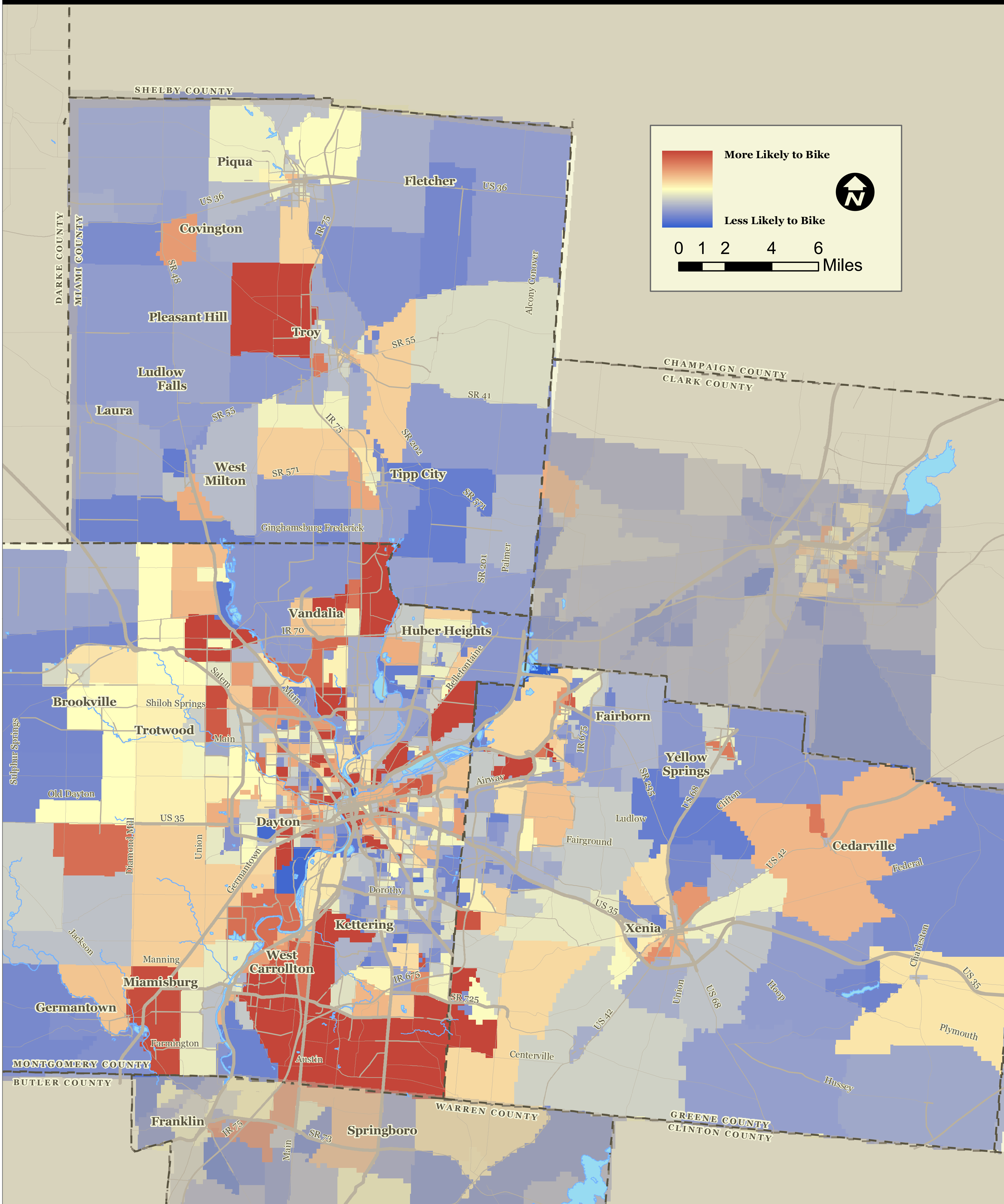

MAP 4-1
Existing and Potential Bicycling Demand

Miami Valley Comprehensive Local-Regional Bikeways Plan

alta PLANNING + DESIGN
mvrpc
BURGESS & NIPLE
Miami County Park District
Five Rivers MetroParks
Miami Conservancy District

OHIO
KENTUCKY
W. VIRGINIA

Data Provided by: MVRPC, State of Ohio, City of Beavercreek, Clark County

Map Prepared by: Alta Planning+Design, Nov 2008

Miami Valley Comprehensive Local-Regional Bikeways Plan

alta PLANNING + DESIGN

mvrpc

BURGESS & NIPLE

MAP 4-2
Cycling Density Attractors

Miami Valley Comprehensive Local-Regional Bikeways Plan

Data Provided by: MVRPC, State of Ohio, City of Beavercreek, Clark County

Map Prepared by: Alta Planning+Design, Nov 2008

MIAMI COUNTY PARK DISTRICT

FIVE RIVERS METROPARKS

MIAMI CONSERVANCY DISTRICT

4.4. BENEFITS ANALYSIS

In addition to models estimating existing and future demand for bikeway facilities, a variety of models can also quantify the benefits of such facilities. Models were used in this analysis to estimate the positive air quality, public health, transportation, and recreation benefits associated with existing and future bicycle/pedestrian travel in the Miami Valley.

4.4.1. Air Quality Benefits

Non-motorized travel directly and indirectly translates into fewer vehicle trips, and an associated reduction in vehicle miles traveled and auto emissions. The variables used as model inputs generally resemble the variables used in the demand model discussed earlier. Data including population, employed persons and commute mode shares were used for this analysis. In terms of daily bicycle trips, assumptions regarding the proportion of persons working at home reflect those used in the demand models. Other inputs included data regarding college student and school children commuting patterns.

Additional assumptions were used to estimate the number of reduced vehicle trips and vehicle miles traveled, as well as vehicle emissions reductions. In terms of reducing vehicle trips, it was assumed that 73 percent of bicycle trips would directly replace vehicle trips for adults and college students. For school children, the reduction was assumed to be 53 percent. To estimate the reduction of existing and future vehicle miles traveled, a bicycle roundtrip distance of eight miles was used for adults and college students; and one mile for school children. For pedestrian trips, a roundtrip distance of 1.2 miles was used for adults and college students, and a 0.5-mile distance was used for children. These distance assumptions are used in various non-motorized benefits models. The vehicle emissions reduction estimates also incorporated calculations commonly used in other models, and are identified in the footnotes of Table 8.

Estimating future benefits required additional assumptions regarding the Miami Valley's population and anticipated commuting patterns. According to the U.S. Census, approximately 409,000 people are currently employed in the region. A future workforce population of 425,000 was used to reflect current projected population changes. In terms of commuting patterns, the walking and bicycling mode shares were increased to address higher use potentially generated by the addition of new bikeway facilities and enhancements to the existing system. The estimated proportion of residents working from home was also grown slightly.

Table 8 summarizes existing and potential future air quality improvements associated with bicycling and walking in the Miami Valley. Combined, bicycling and walking currently remove about 42,000 weekday vehicle trips, eliminating over 95,000 vehicle miles traveled. Bicycling and walking also prevent over 56,000 tons of vehicle emissions from entering the ambient air each weekday. Bikeway and pedestrian network enhancements are expected to generate more bicycling and walking trips in the future. This growth is expected to improve air quality by further reducing the number of vehicle trips, vehicle miles traveled and associated vehicle emissions.

It should be noted that this model only addresses commute-related trips. Unlike the demand models, this model does not account for air quality improvements associated with recreational non-motorized travel. Quantifying the benefits of recreational travel could further improve the air quality benefits of bicycling and walking.

Table 8. Existing and Potential Future Air Quality Benefits

	Bicycle		Pedestrian	
Vehicle Travel Reductions	Existing	Future	Existing	Future
Reduced Vehicle Trips per Weekday (1)	7,566	16,412	34,687	38,629
Reduced Vehicle Trips per Year (2)	1,974,756	4,238,658	9,053,329	10,082,232
Reduced VMT per Weekday (3)	56,327	131,300	39,313	47,760
Reduced VMT per Year (2)	14,701,284	34,269,265	10,260,773	12,465,312
	Bicycle		Pedestrian	
Vehicle Emissions Reductions	Existing	Future	Existing	Future
Reduced PM10 (tons per weekday) (4)	1,036	2,416	723	879
Reduced NOX (tons per weekday) (5)	28,096	65,492	19,609	23,823
Reduced ROG (tons per weekday) (6)	4,089	9,532	2,854	3,467
Reduced PM10 (tons per year) (7)	270,504	630,554	188,798	229,362
Reduced NOX (tons per year) (7)	7,333,000	17,093,509	5,118,074	6,217,697
Reduced ROG (tons per year) (7)	1,067,313	2,487,949	744,932	904,982

Note: VMT means Vehicle Miles Traveled.

(1) Assumes 73% of bicycle trips replace vehicle trips for adults/college students; 53% reduction for school children.

(2) Weekday trip reduction multiplied by 261 weekdays per year.

(3) Bicycle trips: assumes average roundtrip of 8 miles for adults/college students; 1 mile for school children. Pedestrian trips: assumes average roundtrip of 1.2 miles for adults/college students; 0.5 mile for school children.

(4) PM10 reduction of 0.0184 tons per mile.

(5) NOX reduction of 0.4988 tons per mile.

(6) ROG reduction of 0.0726 tons per mile.

(7) Weekday emission reduction multiplied by 261 weekdays per year.

4.4.2. Other Benefits

Bicycling and walking generate benefits beyond air quality improvements. According to Ohio's Physical Activity Plan for instance, almost two thirds of Ohio adults were overweight or obese in 2006. The number of overweight children and teens has also tripled over the past 20 years. Non-motorized transportation can also serve recreational purposes, improve mobility and improve health. The "BikeCost" model, made available by the National Pedestrian and Bicycle Information Center, quantifies these benefits. Primarily focused on bicycling, the model provides a starting point for identifying the potential cost savings of improving the Miami Valley's bikeway and transportation network.

Several modeling assumptions should be discussed. First, the BikeCost model is project-specific, requiring specific information regarding project type, facility length and year of construction. Because this study focuses on a larger study area, several variables were used. The model was based on an addition of 100 miles worth of bikeway improvements with an expected 2016 "mid year" of construction. The model also required other inputs obtainable from the 2000 U.S. Census, including bicycle commute mode share, average population density and average household size. The model assumes that 100 percent of the region's population would be within 1.5 miles of some segment of the system.

Based on the variables described above, the BikeCost model estimated annual recreational, mobility and health benefits. The benefits were quantified based on a combination of research from previous studies as well as other factors (identified in the footnotes of Table 9 below).

Table 9 summarizes the estimated benefits of an enhanced bikeway system in the Miami Valley. Except for mobility benefits, the model outputs are represented on an aggregate basis. Potential annual recreational benefits range from a low estimate of about $12.7 million to a high estimate of over $289 million. Annual health benefits to the region range from about $466,000 to nearly $10.2 million. Mobility benefits were estimated on a per-trip, daily and annual basis. The roughly $4 per-trip benefit could translate to an annual benefit of over $901,000. Decreased auto usage could also generate monetary benefits. As the Miami Valley contains urban, suburban and rural areas, the enhanced network could generate up to about $2.6 million in annual savings from reduced vehicle trips.

Table 9. Estimated Aggregate Annual Benefits of an Enhanced Bikeway Network

Recreational Benefits (1)	Low Estimate	Mid Estimate	High Estimate
	$12,739,630	$195,964,950	$289,316,527
Mobility Benefits (2)	Per-Trip	Daily	Annually
	$4.08	$3,835	$901,140
Health Benefits (3)	Low Estimate	Mid Estimate	High Estimate
	$466,293	$6,904,354	$10,178,053
Decreased Auto Use	Urban	Suburban	Rural
	$1,535,036	$944,637	$118,080

Source: Benefit-Cost Analysis of Bicycle Facilities ("BikeCost") Model, Pedestrian and Bicycle Information Center.

(1) Recreational benefit estimated at $10 per hour (based on previous studies). Assumes one hour of recreation per adult. $10 value multiplied by the number of new cyclists minus the number of new commuters. This value multiplied by 365 days to estimate annual benefit.

(2) Assumes an hourly time value of $12. This value multiplied by 20.38 minutes (the amount of extra time bicycle commuters are willing to travel on an off-street path). Per-trip benefit then multiplied by the daily number of existing and induced commuters. This value then doubled to account for roundtrips, to reach daily mobility benefit. Daily benefit then multiplied by 50 weeks per year and 5 days per week.

(3) Annual per-capita cost savings from physical activity of $128 based on previous studies. This value then multiplied by total number of new cyclists.

4.5. CRASH ANALYSIS

Safety is a major concern for bicyclists. For those who currently ride a bicycle, safety is typically an on-going concern. For those who do not, it is one of the most compelling reasons not to bicycle.

Nationwide, the total number of reported cyclist fatalities has dropped dramatically since 1994, with 802 fatalities reported in 1994 and 725 fatalities reported in 2004. In comparison, total traffic fatalities have increased by five percent over this ten-year period.[2] The same study shows that in 2004, of all Ohio traffic

[2] Traffic Safety Facts, 2004 Data. "Pedalcyclists" NHTSA, DOT # HS 809 912.

fatalities, 1.5 percent were cyclist fatalities (19). This is lower than the nationwide average of two percent. Bicyclist fatalities in Ohio represent a fatality rate of 1.66 per million people.

According to a 1990 study of 3,000 bicycle crashes, the most common type of bicycle-vehicle crash was one where the motorist failed to yield right-of-way at a junction (21.7 percent of all crashes)[3]. More than a third of these involved a motorist violating the sign or signal and driving into the crosswalk or intersection and striking the bicyclist. The next most common types of vehicle-bicycle crash were where the bicyclist failed to yield right-of-way at an intersection (16.8 percent), a motorist turning or merging into the path of a cyclist (12.1 percent) and a bicyclist failing to yield right-of-way at a mid-block location.

These data suggest that a bicycle safety plan should address intersection improvements and education about the rights and responsibilities of cyclists and motorists, especially regarding right-of-way laws. Intersection improvements are especially important where driveways and roadways cross parallel bicycle paths

4.5.1. Regional Bicycle and Pedestrian Collision Analysis

Bicyclist and pedestrian crashes in the Miami Valley were reviewed using data provided by MVRPC. The available data consisted of over 1,300 reported crashes from 2001 through a portion of 2005. It is important to note that some reports were incomplete and therefore lacked essential information for accurate crash type analysis. Finally, all data is obtained from police reports which in some cases may not be objective (due to potentially conflicting accounts of witnesses or those involved in a crash).

Among the reported crashes, most bicycle-related collisions occurred at intersections, with motorists failing to yield the right-of-way to bicyclists representing the primary cause. Bicyclist alcohol and or drug use was the most common factor in accidents where the bicyclist was determined to be at fault. The results from the pedestrian crash data were similar to the bicycle findings. Motorists' failure to yield, followed by alcohol/drug use were citied as the leading contributing causes in most pedestrian-related collisions.

The Project Team also evaluated bicycle/pedestrian crash data to identify problem areas, including corridors and intersections experiencing multiple bicycle/pedestrian-related collisions. Map 4-3 shows high density crash areas in the Miami Valley along with fatality sites from 2002 through 2004. Crash "clusters" include the entire city of Dayton, along with other communities along Interstates 70, 75 and 675. Most reported fatalities occurred in Montgomery County, with most fatal crashes occurring in Dayton.

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[3] Pedestrian and Bicycle Crash Types of the Early 1990's, Publication No. FHWA-RD-95-163, W.H. Hunter, J.C. Stutts, W.E. Pein, and C.L. Cox, Federal Highway Administration, Washington, DC, June 1996.

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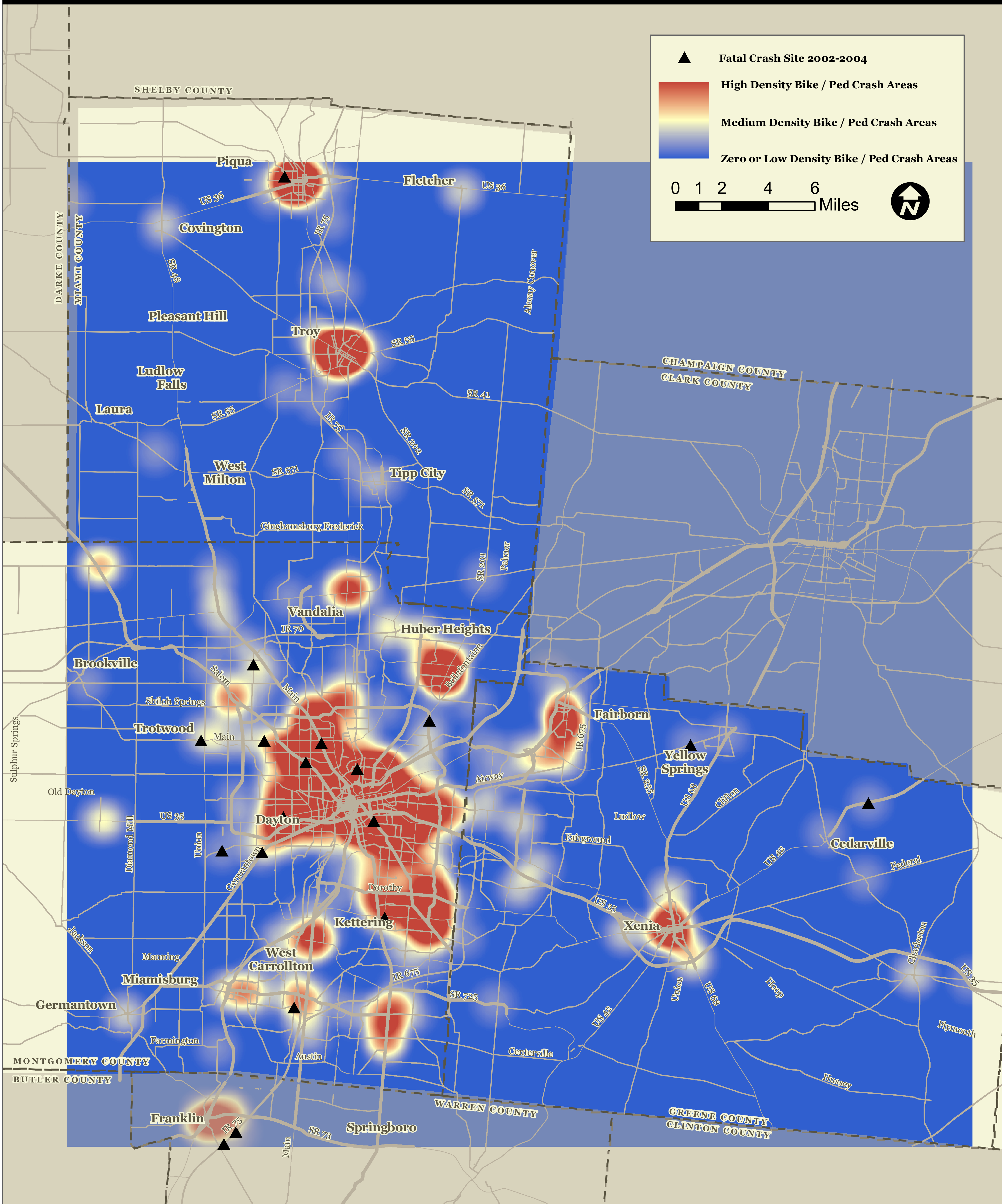

MAP 4-3
Regional Bicycle Crash Analysis

Miami Valley Comprehensive Local-Regional Bikeways Plan

Data Provided by: MVRPC, State of Ohio, City of Beavercreek, Clark County

Map Prepared by: Alta Planning+Design, Nov 2008

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Between 2002 and 2004, several corridors and intersections experienced multiple collisions, with motorists failing to yield the right-of-way representing the primary contributing cause. Table 10 identifies corridors experiencing the highest number of reported bicycle/pedestrian-related crashes.

Table 10. Corridors Experiencing the Highest Number of Reported Bicycle/Pedestrian Collisions, 2002-2004

Corridor	Reported Bike Crashes	Reported Ped Crashes	Total
SR 48	18	35	53
Main St. (Dayton)	11	28	39
Third St. (Dayton)	8	24	32
Salem Ave. (Dayton)	0	26	26
Wayne Ave. (Dayton)	9	13	22
SR 201	7	10	17
U.S. 68	9	7	16
SR 202	10	6	16
SR 4	5	8	13
SR 725	5	6	11
U.S. 40	6	5	11

Source: MVRPC.

The Project Team also identified intersections experiencing the highest number of crashes between 2002 and 2004, summarized in Table 11. Most crashes occurred at high-volume intersections, with motorists failing to yield the right-of-way representing the primary contributing cause. Some reported crashes occurred after motorists disregarded traffic signals or other traffic control devices.

Table 11. Intersections Experiencing the Highest Number of Reported Bicycle/Pedestrian Collisions, 2002-2004

Intersection	Reported Bike Crashes	Reported Ped Crashes	Contributing Causes
Stroop Rd. at Woodman Dr. (Kettering)	5	1	▪ Right-turning motorist struck pedestrian ▪ Right-turning motorist struck through bicyclist ▪ Through bicyclist struck right-turning motorist
SR 201 at Fishburg Rd. (Huber Heights)	2	3	▪ Through motorist struck pedestrian ▪ Right-turning motorist struck pedestrian ▪ Right-turning motorist struck through bicyclist
Keowee St. at Webster St. (Dayton)	0	4	▪ Through motorist struck pedestrian
Main St. at 3rd St. (Dayton)	2	2	▪ Through motorist struck pedestrian ▪ Right-turning motorist struck through bicyclist
Market St. at Staunton St. (Troy)	2	2	▪ Through motorist struck pedestrian ▪ Right-turning motorist struck through bicyclist

Source: MVRPC.

4.6. ON-STREET BICYCLE SUITABILITY ANALYSIS

The Project Team conducted an on-street "bicycle suitability analysis" to evaluate current regional roadway conditions with respect to bicycle comfort and safety. The purpose of the analysis was twofold:

- To identify regional roadways that are currently suitable for bicycle travel, and
- To identify corridors that could become attractive on-street routes with additional improvements in place

The Project Team evaluated the roadway system based on several criteria, including roadway classification, vehicle traffic volumes, posted speeds, number of vehicle travel lanes, outside lane widths, and shoulder widths. Each criterion included a range of possible points (summarized in Table 12), enabling the Project Team to evaluate roadway segments based on a numeric scoring system. The analysis included the following assumptions for each criterion:

- Roadway classification: Roadway segments with lower functional classifications (e.g., Local and Collector streets) received higher evaluative scores, as these streets typically exhibit characteristics attractive to bicyclists.
- Vehicle traffic volumes: Roadway segments with lower volumes received higher evaluative scores.
- Posted speeds: Roadway segments with lower posted speeds received higher evaluative scores.
- Number of vehicle travel lanes: Roadway segments with fewer travel lanes received higher evaluative scores.
- Outside lane widths: Narrow lanes (e.g., eight- to nine-feet wide) received lower evaluative scores given potential conflicts between motorists and bicyclists sharing the same travel lane on major streets, or the extremely close proximity of motorists to bicyclists on roadway shoulders (if shoulders are present). On the other hand, excessively wide lanes also received lower evaluative scores as wider lanes tend to induce higher vehicle speeds.
- Shoulder widths: In general, roadway segments with wider shoulders received higher evaluative scores. In some cases however, roadway segments with extraordinarily wide shoulders (e.g., 20 feet) received lower evaluative scores due to potential use by motorists as acceleration or deceleration lanes as they enter and leave the roadway.

Table 12. Bicycle Suitability Analysis Evaluation Criteria and Point Values

Criterion	Value
Roadway Classification	
Principal Arterial	100
Minor Arterial	500
Urban Collector	900
Rural Collector	900
Local	1,000
Vehicle Traffic Volumes	
<2,000 vehicles per day	1,000
2,001 to 9,999 vehicles per day	500
10,000 or more vehicles per day	0

Criterion	Value
Posted Speed	
50 or greater	0
45	200
40	500
35	700
30	900
25	1,000
20	1,000
15	1,000
Number of Vehicle Travel Lanes	
7	100
6	200
5	500
4	800
3	900
2	1,000
Outside Lane Width	
8	500
9	500
10	1,000
11	900
12	500
Shoulder Width	
<2'	0
2-3'	500
4-10'	700
11-20'	1,000
20' or greater	500

For each roadway segment, the Project Team summed the individual criterion scores to arrive at an aggregate roadway segment suitability score. Map 4-4 presents the on-street bicycle suitability analysis for the Miami Valley region, while Maps 4-5, 4-6, and 4-7 present the analysis results for Greene County, Miami County, and Montgomery and Northern Warren counties, respectively. The maps display the analysis results on a 1-to-6 scale, with "1" representing roadways providing the best opportunities for on-street bikeway enhancements. Table 13 lists the aggregate suitability scoring ranges with their associated map symbology colors and "1-to-6" scale ranges. While the suitability analysis was limited to streets with available data and while the approach does not always address the "gut feeling" of whether a roadway could serve as a desirable bicycle route (assuming physical improvements are made), this approach provides a starting point for laying out an on-street network that will help form a comprehensive bikeway system.

Table 13. Aggregate Suitability Scores and Map Symbology Colors

Aggregate Suitability Score	Corresponding Rating Score	Map Symbology Color
6,000	1	Dark blue
5,000-5,999	2	Medium blue
4,000-4,999	3	Light blue
3,000-3,999	4	Yellow
2,000-2,999	5	Orange
0-1,999	6	Red

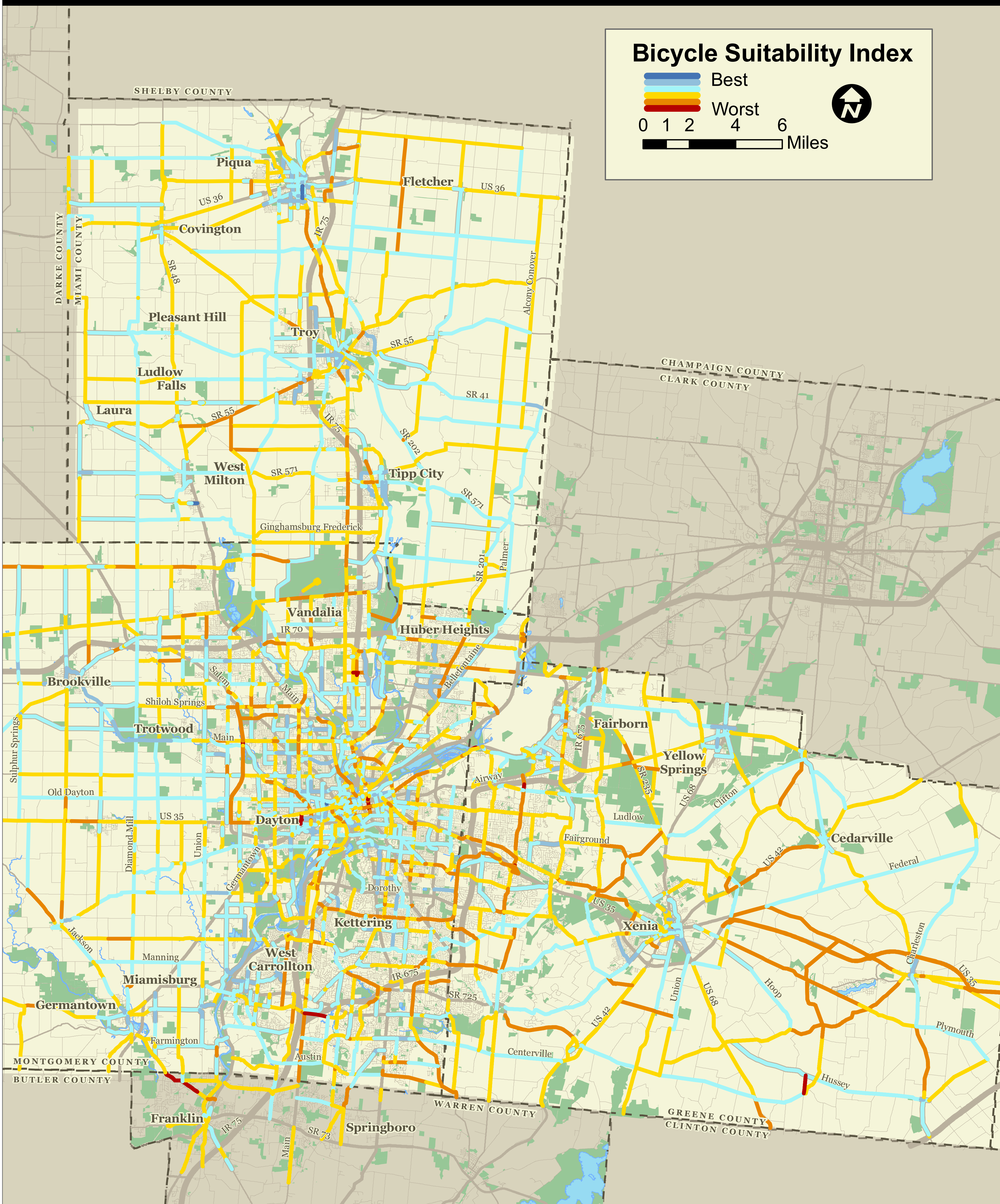
4.6.1. On-going Suitability Analysis

As roadway projects are developed for implementation, it can be helpful to assess the bicycle suitability of the current condition and the project's proposed design. Such an analysis will allow for some estimate of the improvement, if any, in bicycle accommodation from roadway investments. The League of Illinois Bicyclists (LIB) offers a roadway suitability tool on their web site at the following location:

http://www.bikelib.org/roads/blos/blosform.htm

This free tool uses inputs similar to the regional analysis in this report for a single roadway corridor. It generates ratings of roadways based on the Florida "Bicycle Level of Service" (BLOS) and the Bicycle Compatibility Index (BCI).

Miami Valley Comprehensive Local-Regional Bikeways Plan



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MAP 4-4
On-Street Bicycle Suitability Analysis: Miami Valley Region, OH

Miami Valley Comprehensive Local-Regional Bikeways Plan

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MIAMI COUNTY PARK DISTRICT

FIVE RIVERS METROPARKS

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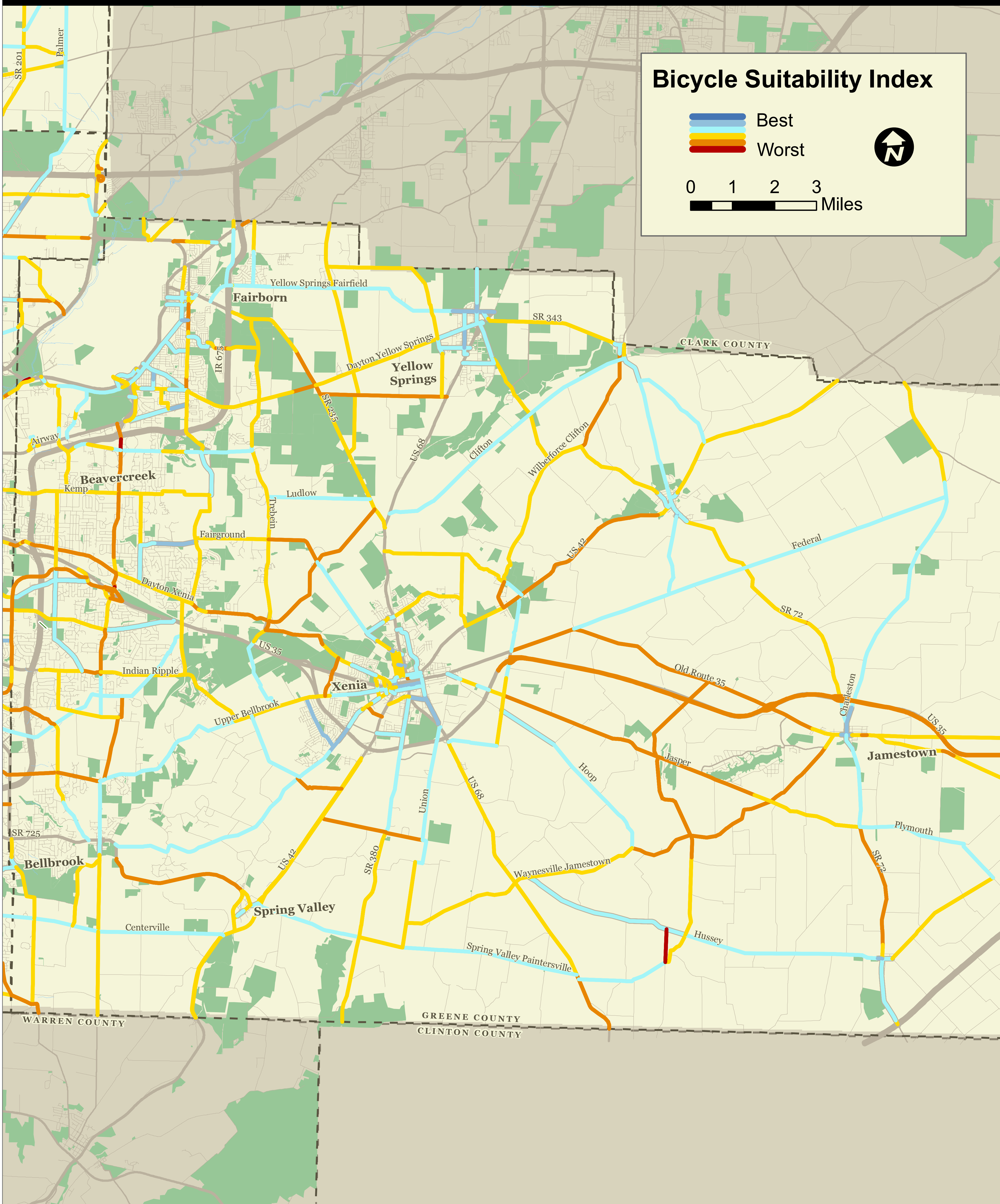
Miami Valley Comprehensive Local-Regional Bikeways Plan



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MAP 4-5
On-Street Bicycle Suitability Analysis: Greene County, OH

Miami Valley Comprehensive Local-Regional Bikeways Plan

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Map Prepared by: Alta Planning+Design, Nov 2008

Miami County Park District

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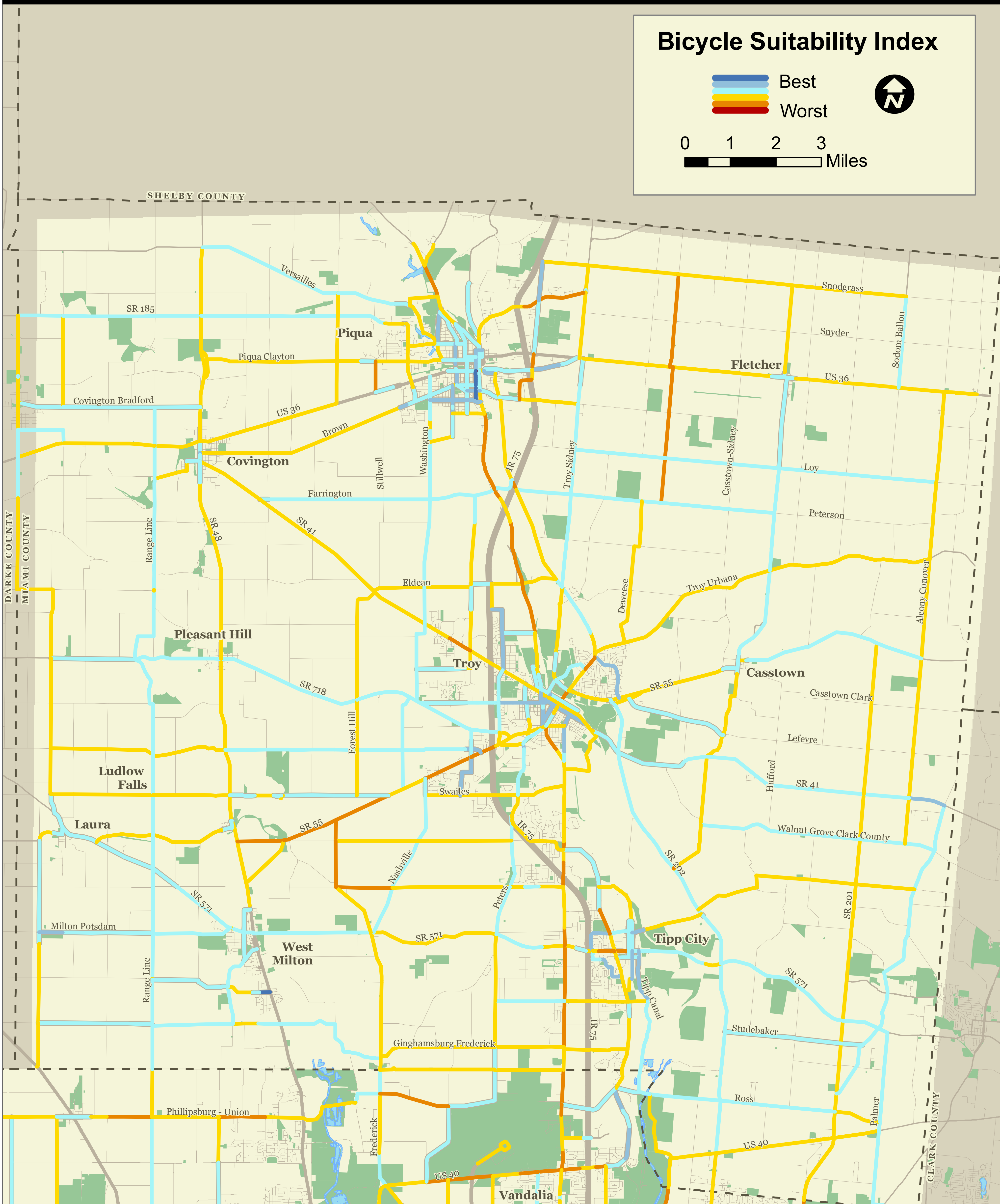
Miami Valley Comprehensive Local-Regional Bikeways Plan



MAP 4-6
On-Street Bicycle Suitability Analysis: Miami County, OH

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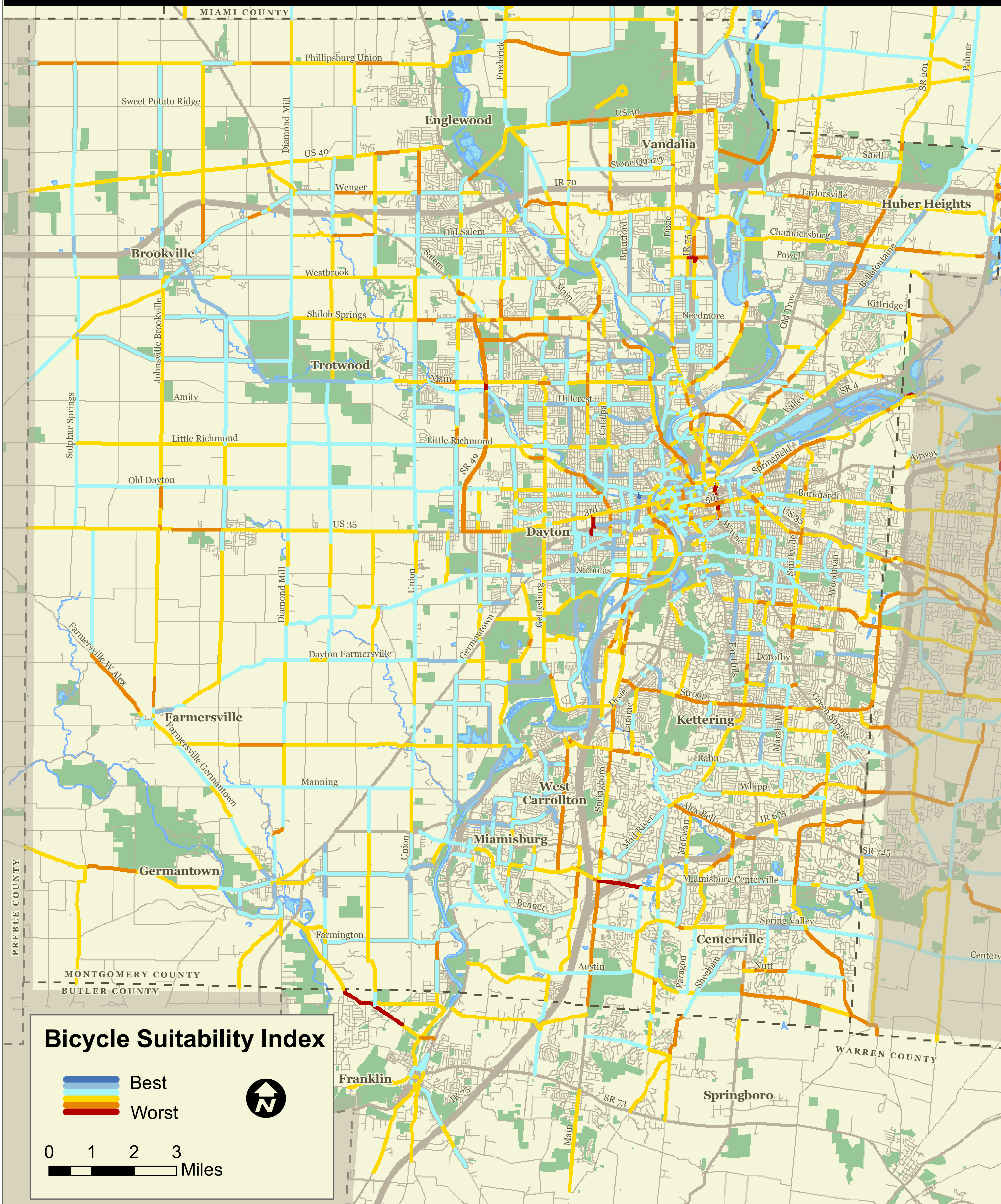

MAP 4-7

On-Street Bicycle Suitability Analysis: Montgomery and Northern Warren Counties, OH

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4.7. SURVEYS

Over the first several months of the Comprehensive Local-Regional Bikeways Plan development process, Staff developed and disseminated a survey to gauge residents' views of the current bikeway system, and to solicit ideas for system-wide improvements. In addition to distributing the survey at major events and to officials representing various municipalities and school districts, the Project Team posted the survey on the project website.

Specific survey questions included the following:

"Do you have specific projects you would like to see in the MVRPC Bikeways Plan?" Respondents could select any or all options:

- "New paved shared use paths"
- "On-road bike lanes and shoulders"
- "Signed on-road bike routes"
- "Safe routes to school"
- "Bicycle parking"
- "Intersection improvements"
- "Access to transit"
- "Education or promotional programs"
- "Other"

Respondents were asked to rate their preference for differing non-motorized facilities, including:

- "Paved shared use paths"
- "Natural surface trails"
- "On-street bike lanes"
- "Signed on-road bike routes"
- "Single track dirt paths"
- "Sidewalks"
- "Equestrian facilities"
- "Water trails"

Respondents were asked to provide a description and location of up to five high-priority projects they would like to see included in the Plan.

Over 600 people responded to the bikeways survey. The following sections summarize survey results:

- Most respondents prefer riding on shared use paths and would use on-street bike lanes and signed shared roadways if they were available.

- Shared use paths and on-street bike lanes represented the most desired bikeway facility types. This indicates that bicyclists desire on-street connections to the Miami Valley's extensive off-street trail system.
- When prompted to identify specific bikeway improvement projects, respondents listed several projects identified in previous planning efforts. This indicates that agencies, for the most part, are responding to user needs and desires.
- Respondents also identified several new projects, many of which were added to this Plan. Some of these newly-identified projects are included in this Plan's Top-Priority and High-Priority project list, described in Chapter 5.
- Beyond recommending infrastructure projects, respondents consistently identified the need for programmatic improvements. These measures include education, encouragement, and enforcement strategies which are equally important to the physical bikeway network.