Pulaski
A Bike Town

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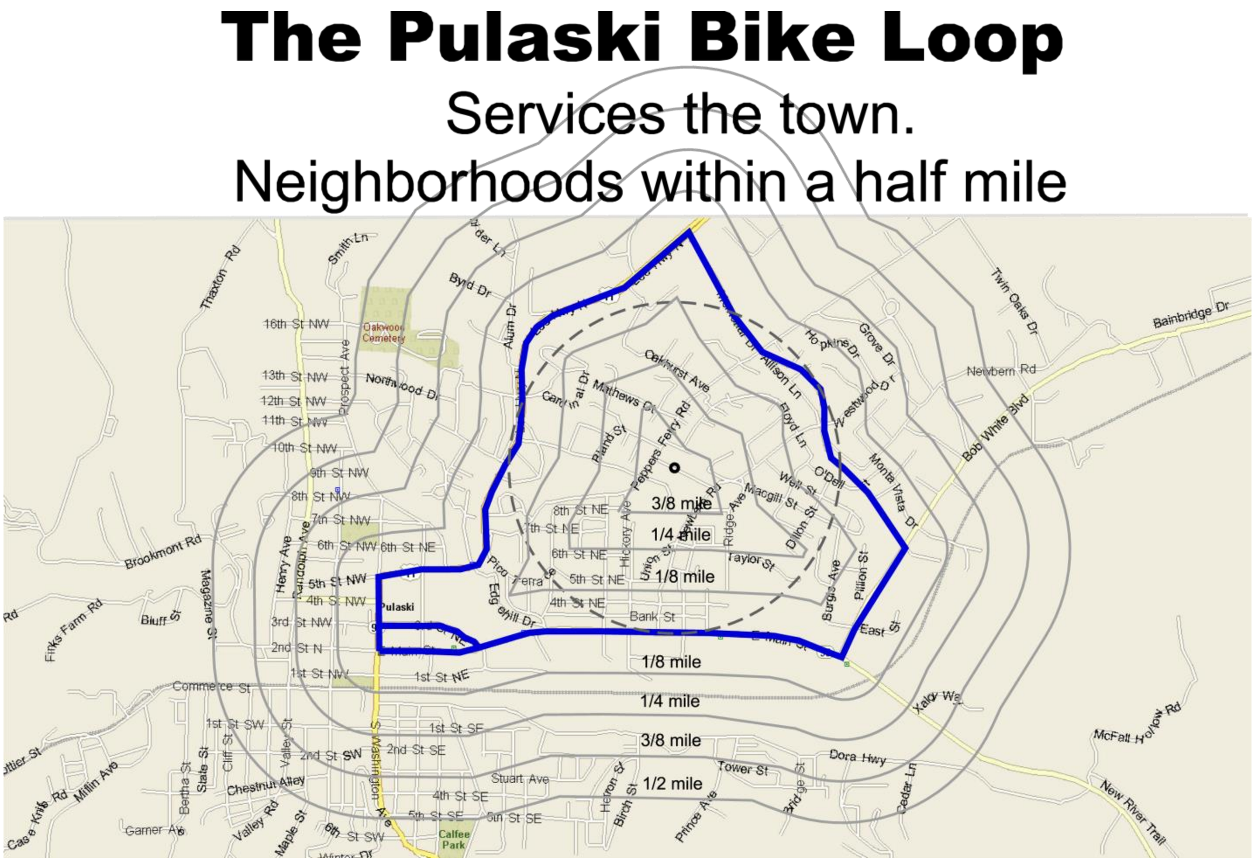
Pulaski A Bike Town

Many of the great bicycling cities of Europe exist because they were walled cities, fortress towns, where for hundreds of years people predominantly walked from location to location within the walls, and to a lesser extent used horses. Now in the modern era these streets are grand for bicycles because *trips are short*, sufficiently so that in prior times they could be made by foot. In this country, we also see the influence of “walking towns,” where at the nation’s inception it was foot power and horse that moved you.

Pulaski, too, was designed to suit the foot and horse. Unlike urban sprawl or intense city traffic concentrations, Pulaski’s streets are a picture-perfect example of what can be attained with a bike loop. A large portion of homes and businesses are within a quarter mile of the loop and much of the town’s area is within a half mile of it.



Notice the circle circumference within the Loop. Its center point is only a half mile from three sections of the Loop. Even more advantageously, much of the town’s residential area is within a mere quarter mile or so of the Loop, with all of the marked area being within a half mile of it. As for the modern influence, the majority of the Loop already has four lane roads so that cars can easily pass bicycles. All of this together creates circumstances which are absolutely ideal for bicycles. *It’s a gimme placed right in our lap.* Even Portland, the great USA biking center, has yet to reach the half mile objective. It’s still struggling to do so.

For those who are indifferent to bikes, please be pragmatic. When streets are attentive to bicycles and pedestrians, economic development and property values go way up, as Charlotte and other major cities have observed. The object here is to point out Pulaski’s huge advantages and to tailor outcomes to suit them.

At the Core of the Program, interactions or cooperation between two or more components produce a combined effect greater than the sum of their separate parts. It's synergy.

In this discussion, the object is not to graft onto the streets of Pulaski some bike program used in a distant city or in the face of urban sprawl elsewhere. Instead, the object is to have an outcome tailored to Pulaski that can breathe new life into the town socially and economically and that can increase safety for pedestrians, bicycles, and cars.

As can be seen in the above map, we are dealing with an area that is in close proximity to the Loop. To get onto the Loop in the first place you will need ride your bike to it, and this will be on streets without any bicycle infrastructure to protect you. So the question arises: "How to increase safety of these streets?" It can be done in much the same manner as in this video – bikes and cars calmly interacting.

By contrast, bike lanes exist to separate bikes from cars. This segregation is not altogether beneficial. Eight states have explicit mandatory bike-lane laws, and elsewhere it is usually presumed that once a bike lane is established cyclists are obligated to stay in that lane. However, motor vehicles sweep roadway debris into bike lanes, making them flat tire prone and a rough place to ride. When avoiding obstructions and making left hand turns, staying in a bike lane is unrealistic. Yet, as this viral video shows, a New York cyclist was ticketed for not riding in a bike lane.

Bike lanes alone can't get the job done. They can cover only a small portion of the total miles that most cyclists actually ride. For modestly populated towns and communities, it would require an absurdly massive infrastructure to have bike lanes everywhere cyclists go. For this reason, safety must in some measure radiate to streets within a wider area. At the modest traffic and bicycle volumes seen in Pulaski, bike lanes would do precious little to radiate safety. They instead are agents of separation. Even less attractively, a bike lane on Rt 99 would be frankly dangerous for bicycles because of frequent right hand turns crossing bike lanes when cars turn into shopping centers and other businesses. This kind of accident is so frequent and famous that it has its own name: "The Right Hook." Let's look for something better.

There is a better solution. An advisory sharrow on Rt 99 is safer because a car making a right hand turn can pull in ahead of you (the cyclist) and travel in the same lane that you are in. In this position you can see what the car is doing and the danger of a deathly sudden right hand car turn is reduced. This is not a theoretical point. In the video here you can watch a woman cyclist ***in a bike lane*** being killed by a truck making a right hand turn (a little boy is also killed in a separate right-hand-turn, bike-lane accident). Please bear with me for a second.

There are important distinctions to make:

1) As discussed, ***bike lanes*** are for the exclusive use of bicycles. The one shown here is on Rt 114 in Christiansburg with roadway debris swept onto it by motor vehicles. On the same day the Radford bike lane on Rt. 11 had roughly an equal amount of debris on it.

2) ***Sharrows*** are sections of a shared road (bicycles & cars) where bicycles should travel. Typically in the United States, a sharrow is designated by the stencil mark with chevron on the road as shown here. As in Portland, they are helpful, but they provide little guidance for vehicles or cyclists as to the precise area that bicycles are to ride in. With good reason, when poorly implemented, they are often viewed as second-rate.

3) ***Sharrows with advisory markings*** go a step further than either of the prior two classes. They provide explicit markings that show the area to be used by bikes. These are ideal on four lane roads with few parked cars, such as those that predominate on the Pulaski Bike Loop. When no bikes are present, cars can travel there.

On the left, we see a sharrow with advisory markings on Brighton Avenue in the Allston section of Boston. The markings are effective because they are closely spaced 60 ft apart (advisory dotted line area, 30' long, 5' wide). Since bikes aren't in this photo, cars are using it. On the right, we see a cyclist on Longwood Ave in Brookline, MA.

Sharrows work when they are done right. They don't work when they are done sloppily or inattentively. Brighton Avenue in the Allston section of Boston is 1.5 miles from Harvard University. Those folk are clever. They knew what they were doing. And they did it right.

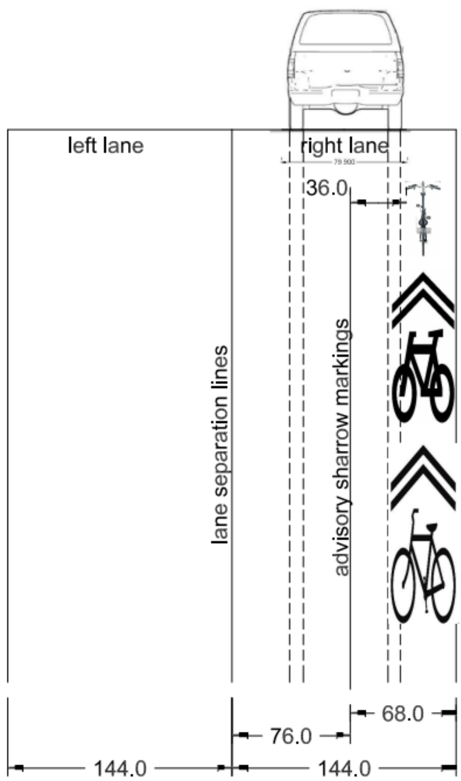
The key items in the "Harvard Plan" that cannot be compromised are: 1) the dotted advisory markings must be identical to those shown, and 2) stencils cannot be placed further than 60 ft apart. Pulaski's tremendous advantages are that roads on the Loop are predominantly two lanes in each direction and there are few areas with parked cars. Thus with minimal dooring risk, sharrows can mainly be on the far right hand side allowing passing space for cars. With these advantages, our circumstances allow us to do even a better job than the Harvard crowd.

We can also be safer. By placing 16 of the following dual signs in each direction of travel on the Loop, we get the message across that Pulaski takes cycling seriously. Vehicles are to take special care that cyclists are treated safely when they are travelling within their designated section of the road. The signs are also educational. By example, they introduce the public to the term "sharrow." Discussions about sharrows become associated with a tendency to yield to cyclists and providing sufficient clearance between bike and car. This aerial view of the "Harvard Plan" shows what it looks like in the real world.

By implementing this program, we set an example for other cities and towns that shows it is possible to do a superior job of accommodating cyclists without massive infrastructure expenses. It comes down to 32 dual signs, stencils, paint, and labor to get the job done. The above signs are intended to promote a frame of mind that benefits pedestrians as much as it does cyclists.

The Pulaski advisory sharrow, an inevitable everyday message.

§ 46.2-839. "Any driver of any vehicle overtaking a bicycle… proceeding in the same direction shall pass at a reasonable speed at least three feet to the left of the overtaken bicycle… and shall not again proceed to the right side of the highway until safely clear of such overtaken bicycle…"



It is difficult for many drivers to judge where that 36" line of separation lays. Yet, every day it would be plain to motor vehicle drivers on the Pulaski Loop, because the advisory sharrow markings in this illustration is 36" from a bike with a 22" handlebar when it is riding at the center of the sharrow chevron.

The Boston advisory sharrows were 60" wide. The advisory markings here are placed 68" from the right hand side of the lane. The additional 8" of width acquaints drivers with a safe passing space between vehicle and bicycle.

The practice of drivers providing this 36" of separation is intended to instill an instinctive habit for motorists overtaking cyclists with ample space even when they are on customary roads elsewhere that have no special provisions for bicycles. The 8" of additional width also makes it possible for bikes in groups to ride in a staggered line fashion within the sharrow.

The illustration points out various practical considerations when an advisory sharrow is placed on a four lane road with no parked cars, as in much of the Pulaski Loop.

For purpose of selection, two different styles of sharrow symbols are shown here. The path of traffic will wear out sharrow symbols over time. Thus, traffic tire paths and periodic maintenance are important considerations. Durability of paint and width of sharrow stencil lines also come into play. Rolling paint may well give a thicker application than spraying. Notwithstanding the current popularity of thermoplastic striping, it is hugely expensive and less amenable to periodic maintenance. Scheduled maintenance where worn portions of the image are periodically touched up with paint is intended to fit with the public-private partnership nature of the project.

	lane width ft	sharrow width ft	remaining vehicle space ft	vehicle width ft	distance to sharrow advisory marking, ft	distance to sharrow advisory marking, in
OK vehicle size, Ford F100 Pickup	12	5.67	6.33	6.33	0.00	0
Compact car	12	5.67	6.33	5.33	1.00	12
Large pickup truck, Ford F250/350	12	5.67	6.33	6.66	-0.33	-3.9

In this illustration, a F100 Ford pickup or any other vehicle 6.33 ft wide or less could pass the bike in the same lane while maintaining 36" of clearance. My compact car could pass in the same lane with 12" of clearance to spare. If a large Ford F250/F350 pickup truck wished to maintain a 36" separation, it would need to move over 3.9" into the left lane.

In all cases it is incumbent on the motor vehicle driver to maintain adequate space between vehicle and bike. Given that Virginia Law (§ 46.2-804) allows drivers to cross double yellow lines to pass a bicycle if the move can be made safely, it is also seems to follow that when it is unsafe for a vehicle to overtake a bike in the same lane on a four lane road, moving into another lane is appropriate.

These are topics that will require greater discussion. The drawing is intended to help visualize components that come into play.

Infrastructure.

A persistent perplexing issue is the debate about how much infrastructure increases bicycle ridership. There is ample historical support for the predominant model that bicycle ridership precedes infrastructure. A contrary position is that when roads are dangerous for cyclists, people will not consider cycling to begin with.

The Netherlands have a long-standing base of cyclists of all ages that use bicycles for getting around, shopping and commuting. Huge protests, some by children, in the 1970s about how cars were overtaking Dutch cities were widely supported. Many of their cities have high population densities, unsuitable for massive numbers of cars. Bit by bit the Dutch focused on bikes and worked toward what arguably is the world's most sophisticated bicycle infrastructure, with crowds of bicycles far larger than we can easily imagine here. Now they annually spend about $31.88 per person on bicycling infrastructure. Scaled to Pulaski's population, that would be equivalent to Pulaski budgeting $283,500 annually for bicycling infrastructure. Cycling is not a sport for them. It's a way of getting around. Rarely are they in a pseudo "Tour de France" mode.

As for Pulaski, the object of the Loop is to get the job done effectively and inexpensively. Pulaski's population density is a mere 10% of Amsterdam's and 7% of Copenhagen's. This reduces the need for infrastructure where the primary object is to separate motor vehicle traffic from bicycles. A better reference point for Pulaski is Haren, Netherlands. Haren's population density is almost identical to Pulaski's, and it's about the same size as Blacksburg. In Haren there are shared space areas (similar to low traffic volume areas near the Pulaski Loop), to which we in Pulaski add the "Harvard Plan" sharrow loop for added safety and order on the town's main four-lane roads.

Size matters. Small is better. Worldwide, cities with a high percent of people bicycling tend to be geographically small with their area containable within radiuses such as these: Pulaski, 1.6 miles; Davis, 1.8; Haren, 2.4; Blacksburg, 2.5; Groningen, 3.2; Copenhagen, 3.3; Amsterdam, 5.2; and Portland, 6.8. Most in-town bike trips are *short*, with distance to destination not exceeding these lengths. To wit, Dutch adults cycle about 1.8 miles per day. When relatively *flat* (rather than hilly) routes are available that also seems to help. In this country when you look at major cycling cities, it is often large university *student* populations that produce the high numbers. "*Short, flat, and young"* provide a boost.

Close to home we see a bit of a mix, Blacksburg being a university town and Christiansburg being a retail and residential center. The Huckleberry Trail is a 7-mile trail between Blacksburg and Christiansburg. The Huckleberry bicycle bridge you see here over Rt 114 in Christiansburg was made possible by a $1 million donation from local resident Renva Weeks Knowles:



Bicycle lanes on Rt 114 seem completely appropriate. I would have expected them to be widely popular because they linked Blacksburg and Christiansburg via the Huckleberry. Yet, I have never seen a single cyclist in the bike lanes here.It is also perplexing that that the bridge does not have direct bicycle ramps to bike lanes. Instead on one side there are steps and on the other there is a “No Trespassing” sign. Undoubtedly there are ways for bikes to get to the trail, but it seems odd that they are not more apparent. Someone appears to have been inatentive to detail, notwithstanding the large amount of money spent on the bike bridge.

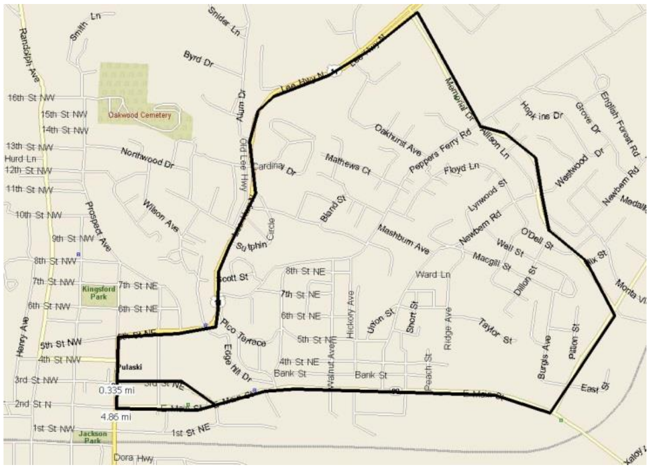
Why sharrows with advisory markings are better for Pulaski than bike lanes.

Ask yourself what other form of bicycle infrastructure scores more favorably for Pulaski in the following categories: immediate implementation, a unified 5 mile bicycle loop connecting key town sectors, exceptionally low cost, prospect of huge benefits, likelihood of increased pedestrian, bicycle, vehicle and scooter safety, and possibility of stemming population and economic decline? I believe you will find the “Harvard Plan” sharrow loop is Pulaski’s champion.

As for the current situation and cost, it is doubtful that there are now a sufficient number cyclists in Pulaski to justify bike lanes in this section of town. Frequently empty bike lanes would be an intolerable eyesore. Sharrows provide a means to assist cyclists when they chose to ride. When cyclists are not there, traffic proceeds normally. This is the most efficient use of the road. It is a flexible solution to adjust to sporadic cycling needs.

As reported in the Southwest Times, the renovation of Pulaski’s Rt 99 is estimated to be a $2 million project. By contrast, for the cost of paint and labor, sharrows with advisory markings can easily be put in place on Rt 99 without any major modifications of the road. The price difference is plainly obvious: thousands rather than millions of dollars. Specifically, a five-mile sharrow loop can be installed now at a tiny fraction of Town’s portion ($71,000) of the proposed $355,000 design study for the 1.2 miles of bike lanes. In short, instant results, better outcome, and far lower costs for the Town with none of the adverse blowback resulting from converting Rt 99 into a two lane road for traffic.

Given that the Pulaski Loop is about the same length as the Huckleberry Trail and can be implemented at trivially low costs should get the attention of thrifty politicians, especially in view of traditional bike lanes averaging about $130,000 per mile, $5,000 per mile at the lowest. When you look at the cost of pavement alone, a traffic lane cost about $120,000 per lane-mile. A bike lane is about a third the width of a traffic lane, perhaps $40,000 per lane-mile for just the pavement in it. At this rate, pavement on a 10 lane-mile Pulaski Loop would cost $400,000 with a traditional bike lane. A “Harvard Plan” sharrow loop does not need new pavement. It uses existing pavement. Money saved.



The shown sharrow loop with advisory markings is 5.27 miles long, with 0.335 miles on the one-way section of 3rd St and a 125 yard leg to Pulaski Bikes and linking to the Dora Bike trail (which in conjunction with the New River

Trail runs 50+ miles to Galax). The Loop is a unifier. It connects to all of Pulaski's major retail centers. It is in close proximity to key residential areas. It links to bike visitors coming from the Dora Trail and invites them to see and shop throughout our town. Many of them will get the message that Pulaski is a very nice place. When we do it right, some will stay, perhaps permanently.

As for those of us who live here, we can commute to key businesses more easily. The increased respectability and availability of bike riding also increases the employment pool that businesses here can draw from. And, it works smoothly with the limited parking in downtown Pulaski. As many Pulaski cyclists already know, it is often possible to get to the door of the Post Office quicker by bike than the time it takes to drive and park a car.

City Rank	Pulaski equivalent total number of Bicyclists	Pulaski equivalent number of commuters	Relative to Richmond Virginia	Percentage of Bicycle Commuters	City	State
	304	21	0.24	0.53%	United States	United States
1	12,602	882	10.02	22.1%	Davis	California
2	5,651	396	4.49	9.9%	Boulder	Colorado
3	4,711	330	3.74	8.3%	Eugene	Oregon
4	4,529	317	3.60	8.0%	Berkeley	California
5	3,864	270	3.07	6.8%	Cambridge	Massachusetts
6	3,630	254	2.89	6.4%	Santa Barbara	California
7	3,432	240	2.73	6.0%	Madison	Wisconsin
8	3,387	237	2.69	6.0%	Gainesvill	Florida
9	3,387	237	2.69	6.0%	Portland	Oregon
10	3,167	222	2.52	5.6%	Iowa City	Iowa
11	3,142	220	2.50	5.5%	Chico	California
12	3,076	215	2.44	5.4%	Missoula	Montana
13	2,879	202	2.29	5.1%	Flagstaff	Arizona
14	2,869	201	2.28	5.0%	Miami Beach	Florida
15	2,709	190	2.15	4.8%	Pasadena	California
16	2,492	174	1.98	4.4%	Fort Collins	Colorado
17	2,330	163	1.85	4.1%	Mountain View	California
18	2,241	157	1.78	3.9%	Boise	Idaho
19	2,065	145	1.64	3.6%	Seattle	Washington
20	2,052	144	1.63	3.6%	Somerville	Massachusetts
21	1,977	138	1.57	3.5%	San Francisco	California
22	1,975	138	1.57	3.5%	Minneapolis	Minnesota
23	1,798	126	1.43	3.2%	Champaign	Illinois
24	1,784	125	1.42	3.1%	Beaverton	Oregon
25	1,782	125	1.42	3.1%	Washington, DC	District of Columb
26	1,776	124	1.41	3.1%	Ann Arbor	Michigan
27	1,718	120	1.37	3.0%	Bellingham	Washington
28	1,696	119	1.35	3.0%	Charleston	**South Carolina**
29	1,684	118	1.34	3.0%	Tucson	Arizona
30	1,533	107	1.22	2.7%	Bloomington	Indiana
31	1,524	107	1.21	2.7%	Salt Lake City	Utah
32	1,465	103	1.16	2.6%	Hartford	Connecticut
33	1,456	102	1.16	2.6%	Paradise CDP	Nevada
34	1,451	102	1.15	2.5%	Portland	Maine
35	1,423	100	1.13	2.5%	Sacramento	California
36	1,405	98	1.12	2.5%	Tempe	Arizona
37	1,373	96	1.09	2.4%	Provo	Utah
38	1,342	94	1.07	2.4%	Evanston	Illinois
39	1,293	91	1.03	2.3%	Santa Monica	California
40	1,258	88	1.00	2.2%	Richmond	**Virginia**
41	1,251	88	0.99	2.2%	Denver	Colorado
42	1,239	87	0.98	2.2%	Lawrence	Kansas
43	1,223	86	0.97	2.1%	Oshkosh	Wisconsin
44	1,205	84	0.96	2.1%	New Haven	Connecticut
45	1,191	83	0.95	2.1%	San Mateo	California
46	1,170	82	0.93	2.1%	Irvine	California
47	1,151	81	0.91	2.0%	Providence	Rhode Island
70	836	58	0.66	1.5%	Mount Pleasant	**South Carolina**
77	771	54	0.61	1.4%	Arlington	**Virginia**
85	723	51	0.57	1.3%	Greenville	**North Carolina**
122	551	39	0.44	1.0%	Wilmington	**North Carolina**
144	472	33	0.38	0.8%	Norfolk	**Virginia**
153	458	32	0.36	0.8%	Virginia Beach	**Virginia**
170	399	28	0.32	0.7%	Alexandria	**Virginia**
179	381	27	0.30	0.7%	Rock Hill	**South Carolina**
203	314	22	0.25	0.6%	Raleigh	**North Carolina**
217	277	19	0.22	0.5%	Durham	**North Carolina**
220	274	19	0.22	0.5%	Portsmouth	**Virginia**
234	251	18	0.20	0.4%	Nashville-Davidso	**Tennessee**
241	242	17	0.19	0.4%	North Charleston	**South Carolina**
270	189	13	0.15	0.3%	Murfreesboro	**Tennessee**
297	138	10	0.11	0.2%	Charlotte	**North Carolina**
306	122	9	0.10	0.2%	Fayetteville	**North Carolina**
307	117	8	0.09	0.2%	Chattanooga	**Tennessee**
313	110	8	0.09	0.2%	Greensboro	**North Carolina**
315	108	8	0.09	0.2%	High Point	**North Carolina**
318	98	7	0.08	0.2%	Newport News	**Virginia**
321	96	7	0.08	0.2%	Chesapeake	**Virginia**
340	76	5	0.06	0.1%	Hampton	**Virginia**
347	71	5	0.06	0.1%	Knoxville	**Tennessee**
348	69	5	0.05	0.1%	Jacksonville	**North Carolina**
362	54	4	0.04	0.1%	Columbia	**South Carolina**
371	40	3	0.03	0.1%	Cary town	**North Carolina**
372	39	3	0.03	0.1%	Winston-Salem	**North Carolina**
374	33	2	0.03	0.1%	Memphis	**Tennessee**

Bicycle usage.

Bicycle usage is a moving target. For bicycle commuters, Virginia is a high growth state. From 2005 to 2014, Virginia commuters increased 87% (an average 7.2% annually). The precise numbers for the town of Pulaski are not known so the following table was developed with city data from the 375 highest bicycle commuting cities and knowing commuters are about 7% of total cyclists.

The list of 375 cities is condensed here to include all US cities with a commuting population greater than 2% and to include all listed cities in nearby culturally similar southern states: North Carolina, South Carolina, Tennessee, Virginia. Cities in red had a lower percent of commuters than average.

The index "Relative to Richmond" in the table indicates usage rate multiples relative to Richmond's usage (Virginia's most active cycling city in the list.)

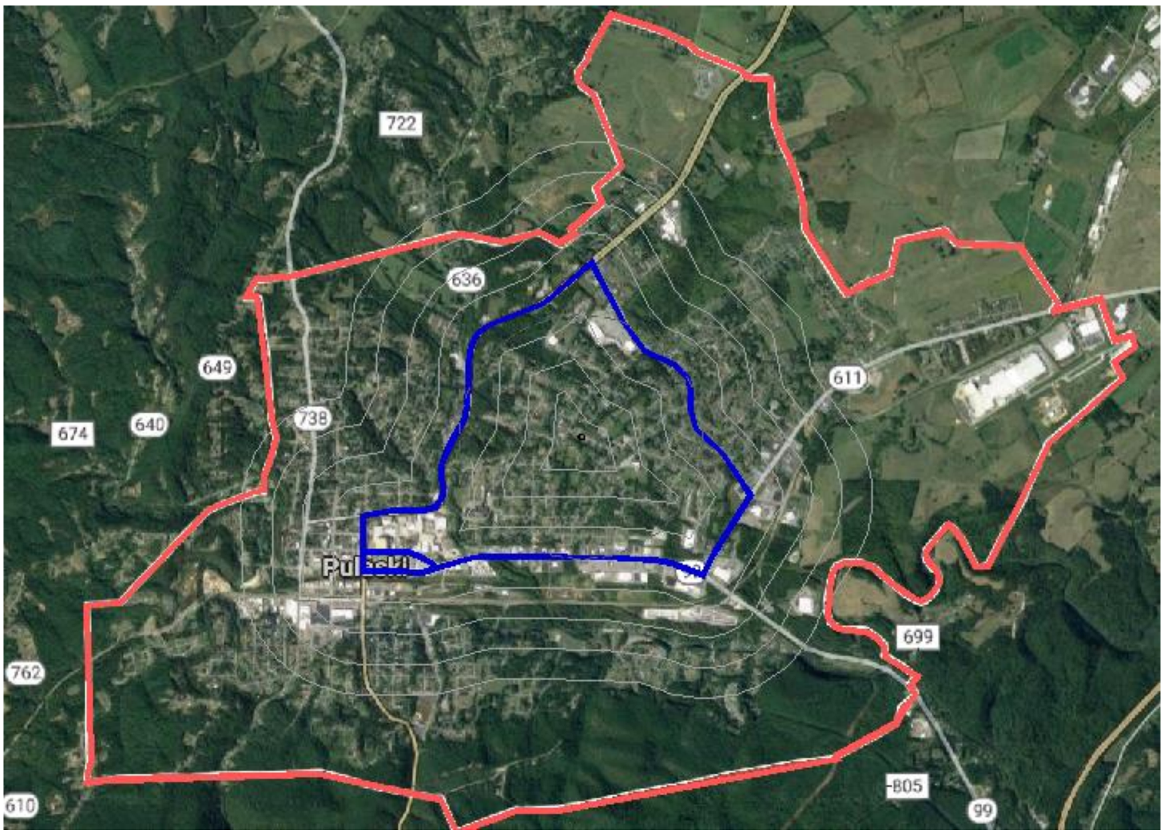
This table provides a first approximation of the number of local cyclists the town of Pulaski can expect when we achieve usage rates equivalent to any of the shown cities.

For Pulaski the message is that if we have cycling characteristics identical to Virginia's average of 0.3% there are about 189 total cyclists and 13 bike commuters here in town, but if we grow to levels experienced in Richmond, VA we can expect these numbers to increase to about 1,258 and 88 respectively. The Richmond region had 18 miles of traditional bike lanes in 2013 and 38 miles in Feb 2016. At this rate the Pulaski Loop and Richmond bike lanes both provide 0.6 miles of length for each sq. mile of area. The 5 mile Pulaski Bike Loop, together with the Dora Trail's access to 50+ miles to Galax, provides ample infrastructure to reach Richmond's biking levels. And we put a positive sheen on the Town, making it evermore an attractive place to live and do business. These are essential ingredients of diversity that make a town interesting and memorable. They also boost economic development.

Consider Damascus, Virginia. Its population is a mere 800. In May of each year it draws 20,000+ tourists. Drive through the town. Look at the number of bicycle and outfitter shops. Treat bikes right and they treat you right.

The Town, The Region – The Low-Density Advantage.

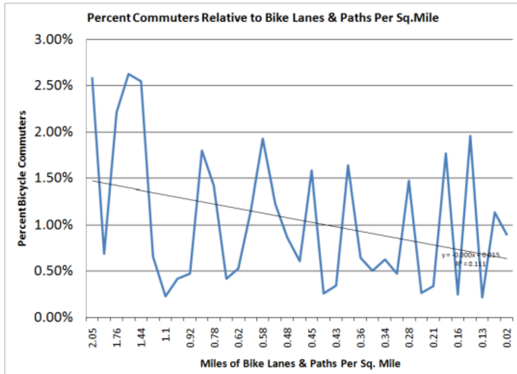
With few exceptions, nearly all of the town's residences are within a half mile of the Loop. Residents on the south side of town who are separated from the Loop by railroad tracks are connected via the Dora Trail. Town border in Red; Bike Loop in Blue:



The photo above tells us a lot about Pulaski cycling. First and foremost we are a rural town which not only has the capacity within our borders to provide a superior Bike Loop, but which offers vast cycling opportunities on nearby country roads. This extends to the Blue Ridge Parkway, which, for example, I have used to cycle roughly 250 miles from Pulaski to central Virginia.

It is wise not to undersell the region. The intention here is to promote safe cycling on roads, provided in the first instance by a "Harvard Plan" Sharrow Loop and its blending with nearby sections of town by what Portland calls "Greenway Cycling." At the core, this "greenway cycling" is cycling on streets in low population density areas having little and slow motor traffic. Pulaski's population density is only 28% of Portland's, perfect for cycling. And, Pulaski's neighborhoods are already at near greenway conditions.

The object here is to have seamless and logically consistent transitions from neighborhood streets, to an advisory sharrow loop, to nearby road cycling that extends to some of the finest cycling areas available anywhere in the nation. It is no accident that the national cross-continental bicentennial bike route comes through here. We have an extraordinary town and an extraordinary region.



Our characteristics differ greatly from the deeply studied cases found in academic journals. For example, the 42 cities in the study above had an average population density more than 5 times greater than Pulaski's and had college student populations ranging from 5% to 12%. Even with these bike-lane imperatives, as you can see above there was no consistent relationship between the percent of bicycle commuters and the quantity of bike lanes & paths available. In the most generous interpretation of this sample, bike lanes & paths were associated with about a one percentage point increase above the current 0.53% city average for bike commuters.

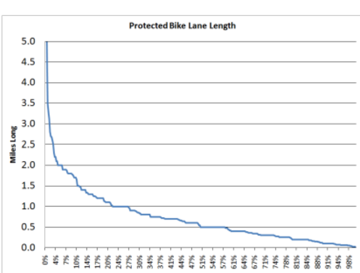
When we look at the correlation (R^2), only 11% of the increase in bicycle commuters could be explained by bike lanes & paths. The remaining 89% of the graph-line movement is explained by other factors.

It is these "other factors" that make tailoring a bike program to the town so imperative. Even in advocacy, to do otherwise is to irresponsibly oversell a single component without accounting for how it fits in the broad overview.

Protected, but not protective?

Traditional bike lanes are frequently trash pits on the side of the road reserved for highway rejects. Especially in large cities, that received message has prompted many to press for protected bike lanes. I feel their pain. In the late 1960s I worked at NYU Medical Center. One day I awoke with the bright idea that I would cycle to work.

On that warm day, I was motivated to keep well ahead of one apoplectic cab driver who from his window hurled every insult at me that his vocabulary could manage. You see in those days there were literally no cyclists on the road. My introducing him to the fact that a bicycle could stay comfortably ahead of him in city traffic deeply disturbed his sensibilities. Progress, however, came to a sudden stop when a policeman prohibited me from crossing the Williamsburg Bridge (cars-only then, now a bikeway on it). I ended up carrying my bicycle across the Brooklyn Bridge, thus ending my NYC commuting experience.



In sharp contrast to Pulaski's low population density, the most satisfactory solution with vehicles operating within NYC's high population and traffic densities, seems to be the protected bike lane. They have been successful there. Indeed, it is now protected bike lanes (not traditional bike lanes) that are the shining items in the wish box of many cycling advocates.

But streets are not infinitely wide. They are not tabula rasas that you can easily draw your dreams on. There is a finite amount of space to work with and limited funds. When we look at the inventory of US protected bike lanes, we find that only three are longer than five miles. The longest is 10.4 miles – the long ones being predominantly in NYC.

Most US protected bike lanes are a half mile or shorter. Only 10% of are longer than 1.7 miles, which seems to speak to practical difficulties of installing them. Sophisticated electronic controls at intersections and complex infrastructure in Dutch cities illustrate the huge commitment necessary, politically and financially.

Before giving protected bike lanes a pass, it is well to remember first principles: ***Slow is safe. Intersections are dangerous.*** As *Bicycle Quarterly* points out from a study of the Belgian city of Antwerp: The biggest accident risk occurred in separated (i.e., protected) bike lanes that ran along low-traffic neighborhood streets with many intersections. In this case, riding in the protected bike lane was similar to riding on the sidewalk, which is known to be the least safe location for cycling.

Speed Limit	No Infrastructure	Painted Bike Lanes	Protected Bike Lanes
12 to 20 mph	1.00	4.75	6.21
30 mph	1.33	1.43	1.62
40 mph	1.70	1.82	0.90

In this table Antwerp's risk of bicycle accident is normalized to 1.00 for slow neighborhood streets with no infrastructure. This corresponds to the state of most neighborhood streets here in Pulaski. These streets with no infrastructure are some of the safest biking streets available. If the above data holds true, to add protected bike lanes to them would increase risk of accident about six fold. So while protected bike lanes have advantages for cities of the NYC ilk, less dense cities with slower traffic may be well advised to take population density and traffic speed into account. Population and traffic greatly change the character of a street. Manhattan's population density is 11 times greater than Antwerp's. Pulaski is one fifth as dense as Antwerp.

Speed Limit	Painted Bike Lanes	Protected Bike Lanes
12 to 20 mph	4.75	6.21
30 mph	1.07	1.22
40 mph	1.07	0.53

Looking at the same categories and comparing risk with no infrastructure to traditional bike lanes and protected bike lanes, we see at 30 mph and above bike lanes produced a modest increase of danger in all cases except the protected bike lane at the 40 mph speed limit, where risk of accident was cut in half. If this data is representative, it gives little comfort to those who blanketly promote bike lanes.

In our little low-density town, the challenges we face are far less complicated than in big cities, as are the solutions. Because our traffic and population density is so much lower than cites, we can get a far better outcome than they can. As shown in the diagram on page 4, we can easily keep cars 36" away from bikes. That gives us safety of the kind desired by protected bike lanes. And by systematically familiarizing motorists with space needed for cyclists, we address the human aspect so that humans in cars and humans on bikes can proceed happily and well in our town, whether on or off the Bike Loop.

Pedestrian and vehicle safety in tandem with bicycles.

Although Pulaski's present bicycle usage rates are low, every increase benefits the community. It is well to note that far more pedestrians than cyclists are killed by cars. In the United States, 4,280 pedestrians and 620 bicyclists are killed annually. These deaths constitute about 14 percent of overall traffic fatalities. Studies show that for bicyclists and pedestrians there is safety in numbers. The more bicyclists and walkers on the streets, the more attuned drivers are to their presence. Fatality data illustrates this. So even if you don't bike, your streets are safer for you, your children, and your community when bicycles are there. With sharrows being right on the street sharing the road with cars, they are doing the yeoman's work of making streets safer for you.

Some drivers seem to entertain the notion: "I am driving a $30,000 vehicle. That bicycle is an annoyance. If it weren't for the aggravation and possible dent on my car, I wouldn't mind banging it out of my way." However, when friends, your children, and folks you know are on the Loop and the repeated symbols there remind you of them, a calming influence may set in. Bicycle author Robert Hurst refers to this sharrow effect as "preemptively calming motorists."

Consider the Pulaski Loop. It is five miles long, ten miles of sharrow markings for the right and left sides of the road. In the "Harvard Plan" sharrow markings are spaced 60 ft apart. With this close spacing there are *hundreds of these markings* on the Loop that drivers see whenever they drive through town. These reminders impart safety.

The circumstances in the following table are causes or contributory causes of motor vehicle accidents. The second percentage column in the table shows the cumulative percent that includes prior categories. Before even getting to conscious decision errors, 75% of accidents can be attributed in part, or in whole, to Driver Inattention, Vehicle Speed, Alcohol Impairment, or Perceptual Errors.

Driver Inattention	23%	23%
Vehicle Speed	19%	41%
Alcohol Impairment	18%	60%
Perceptual Errors	15%	75%
Decision Errors	10%	85%
Incapacitation	6%	91%
Other	9%	100%

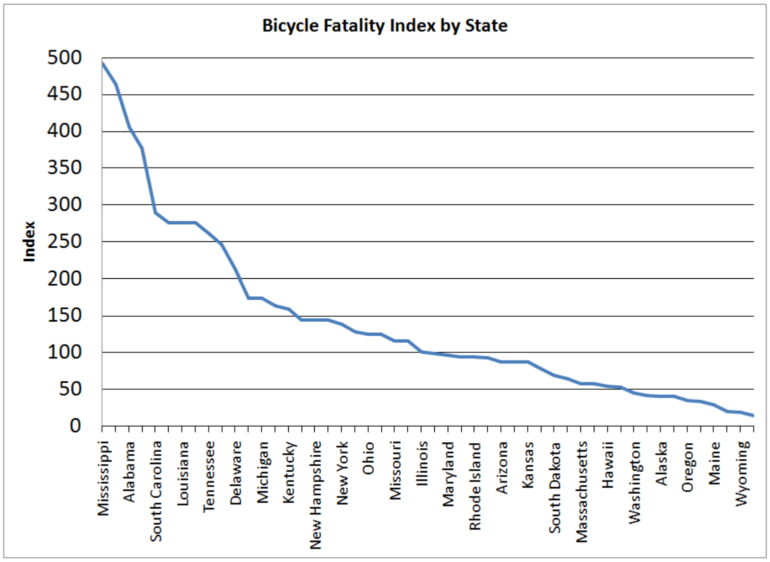
At present the influence of the "Harvard Plan" on accidents is conjectural. Fifty-seven percent of all causes (Driver Inattention, Vehicle Speed, and Perceptual Errors) may be favorably influenced. Since the Loop and its repeated markings are so close to so many town streets, it is not beyond reason to expect that some of its safety measures will radiate to nearby areas on the map, which happens to be the majority of the town – a bonus perhaps being road safety coming from a bicycle plan.

As for the Loop itself, it may have practical unanticipated side benefits such as cars also keeping a safe distance from scooters when they, too, ride within the advisory markings. The experiment with the "Harvard Plan" Bike Loop is intended to have synergetic outcomes for bicycle and road safety in various ways, whether directly on the Loop or in neighborhoods in close proximity to it.

Safety, the power of the Loop.

When discussing bicycle safety, there are two objects: 1) to reduce accidents regardless of level of severity, and 2) to reduce fatalities.

Truth be told, the latter is frequently sloppily handled – data dreadful and analysis insufficiently rigorous. There is effectively no nationwide comparative fatality data that we can rely on for road-side bike lanes, sharrows, protected bike lanes, and separate bike/multiuse paths. And, the data that exists focuses on high population density cities, not low-density small towns. It also fails to clarify fatality risk posed by other transportation modes, such as motorcycles, which seem to be [far more fatality prone than bicycles](#).



While I would like to see analyses for small towns, we may be missing a highly pertinent point: *the vast difference between the risk of death depending on what state you are riding in*. When states were unsafe, they were often wildly unsafe.

Fatality Index By State

1	**Mississippi**	**493**	26	**Iowa**	**99**
2	**Arkansas**	**464**	27	**Maryland**	**97**
3	**Alabama**	**406**	28	**Pennsylvania**	**94**
4	**North Carolina**	**377**	29	**Rhode Island**	**94**
5	**South Carolina**	**290**	30	**Nevada**	**93**
6	**Florida**	**275**	31	**Arizona**	**87**
7	**Louisiana**	**275**	32	**California**	**87**
8	**Texas**	**275**	33	**Kansas**	**87**
9	**Tennessee**	**261**	34	**Wisconsin**	**79**
10	**Georgia**	**246**	35	**South Dakota**	**70**
11	**Delaware**	**213**	36	**Utah**	**65**
12	**Connecticut**	**174**	37	**Massachusetts**	**58**
13	**Michigan**	**174**	38	**North Dakota**	**58**
14	**New Jersey**	**164**	39	**Hawaii**	**55**
15	**Kentucky**	**159**	40	**Minnesota**	**54**
16	**Indiana**	**145**	41	**Washington**	**45**
17	**New Hampshire**	**145**	42	**Colorado**	**42**
18	**West Virginia**	**145**	43	**Alaska**	**41**
19	**New York**	**139**	44	**Nebraska**	**41**
20	**New Mexico**	**128**	45	**Oregon**	**35**
21	**Ohio**	**126**	46	**Idaho**	**34**
22	**Oklahoma**	**126**	47	**Maine**	**29**
23	**Missouri**	**116**	48	**Vermont**	**21**
24	**Virginia**	**116**	49	**Wyoming**	**19**
25	**Illinois**	**101**	50	**Montana**	**14**

By this table (same as the graph), it would be 24 times safer to ride in Vermont than in Mississippi [23.8=493/21]. This difference *is huge*. As unpleasant as fatality data is, it is telling us something.

Much of bike safety seems to fall outside the realm of traffic engineering and to lie squarely in the domain of human conditions – the mindsets we motorists have when we get behind the wheel. The differences in the table are too great to expect otherwise.

The median is at 100, Virginia almost hitting it exactly. As seen in the graph, many other states similarly hover around this midpoint, the dangerous ones sharply exceeding it, and many of the safer ones being about twice as safe. Perhaps we would be wise to look at states like Maine and Vermont to study what produced bike safety there. [The graph and table were created based on state fatality data per capita adjusted for state bicycle commuting rates and normalized to produce an index with a median at 100. It is a first approximation and should not be considered cast in stone.] By way anecdote, studying safety statistics should never lead to a false sense of security. Ken Kifer studied danger per hour of bicycle activity as a means for assessing bike safety. Ironically, he was killed while riding his bike. Drunk driver. In Alabama. Both being dangers pointed out in these pages.

As for engineering Pulaski streets for bicycles, the inconvenient truth is that city and town blocks are short. Intersections in downtown Pulaski, often occur at a rate of 8 to 15 times per mile, depending on direction of travel (more frequent North-South than East-West). Intersections are key danger points. In New York City 89% of fatal bicycle crashes occurred within 25 feet an intersection. Cyclists here in Pulaski deal with intersections whenever going from point A to point B. *The Art of Urban Cycling* points out, "When new bicyclists have to cross an intersection, they are often unappreciative of the level of danger that intersections pose. They are wide-eyed, hopeful, and innocent, and accident numbers reflect that. … Bike-car wrecks usually involve vehicles that are turning or crossing, and a street rider will have to deal with these dangers, bike lane or no bike lane. Motorists smash into cyclists in bike lanes all day long." Forester in *Effective Cycling* dedicates a complete chapter to intersection dangers. In *Bicycle Transportation*, he was often strident in his opposition to bike lanes alleging, "accident rate per bike-mile on bikepaths are 2.6 times their rate on roads."

Rather than focusing on fatalities, his assertion addressed accidents in general (ratio of injuries to fatalities is about 80 to 1). In a list that included falls, bike-bike collisions, bike-dog collisions, and other causes, he attributed 17% of accidents to car-bike collisions. In *Effective Cycling* he states that children had one accident one per 1,500 miles; college-associated adults, one per 2,000 miles; and experienced club cyclists, one per 10,000 miles. Similarly, Hurst in the *Art of Cycling* reports careful cyclists crashing about once every 4,500 miles; those riding 2,400 miles per year suffering accident-related injury once every 9,000 miles; Brits, once every 15,000 miles; with 14 years experience, once every 30,000 miles. In short, as Hurst says, "accident rates decline big-time as experience is gained." When you look to the Dutch, it's also experience that is a path to safety, as this video nicely points out.

Commonly we learn by experience. That experience can be accelerated by thinking in advance before ever getting on a bike. Bicycle accidents fall into a class of statistical problems known as "waiting time problems." Because of this, it is possible to compute the probability of accident at different accident rates, as in the following table. At each of the shown skill levels, assuming 17% of accidents are car-bike accidents, we can approximate probability of a car-bike accident within a given number of miles ridden, of these about one in 19 are apt to be very serious.

Probability of Car-Bike Accident

Skill Level, average miles per accident of any kind	25%	50%	75%	90%	99%
1,500	2,538	6,116	12,232	20,317	40,634
2,000	3,384	8,155	16,309	27,089	54,178
2,400	4,061	9,786	19,571	32,507	65,014
4,500	7,615	18,348	36,696	60,951	121,902
9,000	15,230	36,696	73,392	121,902	243,803
10,000	16,922	40,773	81,547	135,446	270,892
15,000	25,384	61,160	122,320	203,169	406,339
30,000	50,767	122,320	244,640	406,339	812,677
Avg. number of accidents of any kind	1.7	4.1	8.2	13.5	27.1

Let's say you ride your bike daily on short trips in Pulaski, that may well amount to about 1,000 miles a year, 2.7 miles a day, 8,000 intersections a year (at eight intersections per mile). Each of those intersections is an acute danger point. If your skill level were that of a college-associated adult with 2,000 miles between accidents, the table here suggests that there would be a 50-50 chance of one car-bike collision within 8.1 years [8.1=8,155 miles at 50% chance of a car-bike accident/1,000 miles per year]. A careful cyclist at 4,500 miles between accidents might well expect a 50% chance of a car-bike accident within 18.3 years [18.3=18,348/1,000]. For a club cyclist at 10,000 miles between accidents, it might be a 50% chance within 40.8 years [40.8=40,773/1,000]. So what to do?

Be a Girl! After adjusting for number of trips made by women, women are 2.4 times less likely to be involved in a fatal accident. Ride only in daylight hours! Half of all fatal bicycle accidents occur at night, dusk, or dawn. The absolute safest times to ride in a week are between 9 AM and 6 PM on weekends. Contrariwise, weekends from 6 PM to midnight are definitively the most dangerous times, 2.5 times more dangerous. Keep alcohol out of your blood! Twenty-four to thirty-two percent of fatal bicycle accidents involved detectable amounts of alcohol. Never make a mistake at an intersection! At 8,000 intersections per year you don't have the luxury of error. Making even one mistake at an intersection is serious. In 93.5% of the cases when passenger cars are involved in a bike fatality, the point of impact is either the front or right side of the car. Never let the front or right side of a vehicle get anywhere near you at an intersection. Lay back. Never get caught in the path of a right-hand turning vehicle. This is the undramatic, peaceable looking accident that kills. A large truck is 7 times more likely to kill a cyclist on right side impact than a passenger car is. Right-turn accidents are the easiest and most often avoided accidents in advance, but if addressed after a cyclist is squeezed by a right-hand turning vehicle, too frequently there is no remedy.

Forget the Tour de France! Remember cognitive errors: "Looked but did not see," "Selective Attention," "Change Blindness," "Saccadic Masking," and SMIDSY ("Sorry, mate, I didn't see you"). Useful videos along these lines: 1, 2, 3, 4, 5, 6, 7. When people devote their attention to a particular area or aspect of their visual field, they tend not to notice unexpected objects, even when those unexpected objects are potentially important and appear right where they are looking. Bicycles are precisely the unexpected objects they tend not to see. They are thin. They break the expected and agreed-upon pattern of the road; they offend the moral order of the road. If a cyclist is fast moving on a city street, it is doubly likely to be missed. Consider Pulaski, distance to destination seldom exceeds 1.6 miles. A fast moving cycle at 18 mph would arrive a mere 1.5 minutes earlier than a slower 14 mph cyclist. Sacrifice a few seconds. Slow down for intersections when cars are present. There is no way to know with certainty what they will do. Slow is safe. In the extreme case, it also has the advantage that in the event of a collision with a stationary object, the force of impact is 60% of what it would have been at 18 mph [the physics of it: force is to the square of velocity].

An equally unattractive story can be told about cars. Fortunately, there is a nice way we can compare cars and bikes. In Virginia there were a total 703 traffic fatalities. The data shows 0.30% of trips in Virginia were made by bicycle. With this information, we would know that, if per trip, bicycles and cars were equally safe, there would have been 2.1 bicycle fatalities in the state [2.109=703*0.30%]. But this was not the case. There were 12 bicycle fatalities, a 9.9 excess fatalities [9.9=12 - 2.1]. These 9.9 excess fatalities represent the increased danger posed by bicycle trips relative to the average risk of death in a car trip in Virginia.

From this logic, we can also measure the consequences of adopting safe bicycling practices. For example, we know that not riding at night reduces fatalities by half. Employing this safety practice in Virginia would have saved 6 lives, dropping to 6 bicycle fatalities [6=12/2]. In Virginia, the danger for cyclists employing the practice of daytime-only cycling would have been ranked at 3.9 excess deaths statewide relative to deaths otherwise produced by motor vehicles [3.9=6 - 2.1]. Even these 3.9 deaths could have been eliminated had cyclists been keenly attentive to intersection dangers. Notwithstanding that cycling presents real dangers, it can be made far safer. All modes of transport have dangers that must be plainly accounted for, which is to say don't give motor vehicles a pass. As you will see, in some states, cycling trips already seem to be safer than car trips.

The above relates primarily to the first component: the skill of the cyclist. The second component is a lack of motorist skill that may be beyond the capacity of the cyclist to counteract. For this we need protection. The Loop gives it by motorists habitually maintaining 36" of separation between vehicle and bicycle, and yielding to cyclists when they are in their portion of the road. The Loop also strikes at a point that goes beyond street engineering. Consider lines on a highway, "Each dashed line measures 10 feet, and the empty spaces in-between measure 30 feet. So every time a car passes a new dashed line, the car has traveled 40 feet." The "Harvard Plan" markings that we have seen in photos here are 60 feet apart, 1.5 times further apart, but still close enough to make an unavoidable impression on the driver – close enough to establish a new moral order, a new pattern of the road, a pattern that converts "unexpected objects" into "expected objects." From the above videos, we know that "Selective Attention" produces the "Looked but did not see" effect that is the cause of most accidents. By repeatedly placing bicycles within the focus of attention, the Pulaski Loop does what no other bicycle infrastructure does: it makes the previously vulnerable & unexpected far safer, within the Loop and elsewhere too.

	Excess Bike Deaths	Excess Bike Death Index Population Adjusted	Bicycle Fatality Index	Bicycle Mode Share Index	Protected Bike Lanes Centerline Miles	Road Fatality Index Population Adjusted
Florida	124.0	488	283	133	4.66	112
California	97.3	196	80	222	34.27	72
Texas	42.9	125	226	44	19.71	122
New York	40.8	162	113	111	78.94	47
Illinois	21.5	130	85	133	34.46	66
Arizona	21.3	248	105	222	1.3	104
Michigan	18.4	145	135	89	0	84
Georgia	16.7	129	229	44	3.7	107
North Carolina	16.4	129	232	44	0.35	120
Pennsylvania	14.2	87	90	89	5.49	87
South Carolina	11.5	187	235	67	0	158
Virginia	**9.9**	**93**	**117**	**67**	**1.2**	**78**
New Jersey	9.3	82	100	67	2.47	57
Louisiana	9.1	152	157	89	0	147
Indiana	9.0	107	111	89	13.45	105
Alabama	8.2	132	451	22	0	158
Ohio	8.0	54	77	67	4.4	81
Utah	7.0	185	93	178	1.89	79
Nevada	6.6	181	137	111	2.1	94
Arkansas	6.5	172	574	22	2.4	146
Massachusetts	5.7	66	41	156	7.05	45
Kansas	5.5	147	147	89	0.28	123
Mississippi	5.4	141	487	22	0	189
Tennessee	4.0	48	186	22	9.28	138
Maryland	3.7	48	68	67	1	69
Colorado	3.7	53	35	289	9.14	84
Wyoming	3.7	489	231	200	0	234
Missouri	3.5	45	100	44	1.42	118
Hawaii	3.1	173	76	200	2.1	60
Washington	2.8	32	27	200	12.72	61
New Hampshire	2.8	166	275	44	0	65
Kentucky	2.7	47	110	44	0.53	143
Delaware	2.6	221	260	67	2	119
Minnesota	2.5	35	32	156	8.4	62
Iowa	2.4	60	63	111	0.98	96
North Dakota	2.3	246	197	111	0.2	168
New Mexico	2.3	87	83	156	0	171
Alaska	2.3	241	99	222	1	90
Connecticut	2.3	49	68	67	0	64
Oklahoma	2.0	40	84	67	0	162
West Virginia	1.7	73	263	22	0.9	138
Maine	1.3	79	73	111	0.6	91
South Dakota	1.3	121	114	111	0	148
Nebraska	0.88	36	52	111	1.3	112
Wisconsin	0.45	6	24	156	1.91	82
Idaho	**-0.05**	-2	27	244	0	106
Rhode Island	**-0.21**	-15	0	89	0.25	46
Vermont	**-0.31**	-38	0	156	2.7	66
Montana	**-0.69**	-53	34	311	0.48	175
Oregon	**-1.21**	-24	19	511	10.22	83
Total	567				285	
Median	3.7	100	100	100	1.3	100

Excess bicyclist deaths, state by state.

Beyond the average occurring rate of road fatalities for all vehicles, cyclists in most (but not all states) incur an excess number of deaths. This is useful measure of the risk of death faced by cyclists relative to other modes of road traffic in a state. For advocacy, for taking corrective action, and for having a realistic understanding of risks faced by cyclists, it is especially handy.

Here excess deaths were calculated using the same method as Virginia's excess 9.9 cyclist deaths discussed above. By this measure, Virginia is the 12th highest ranking state, but when adjusted for population it is at 93 on the Index, which suggests that relative to the state's road transport, it is about in the middle of the pack. The center point on all of the Indexes is 100. Similarly Virginia's bicycle fatality index is close to the middle. For most vehicles Virginia's roads in general are considerably safer than most states: 78 by its Index. But despite the state's beauty and suitability for cyclists its bicycle mode share is a paltry 67% of the median.

For the great states, look at the bottom of the list. Here we see states where cycling seems to have been safer than travelling in a car (excess deaths in the negative territory). Look at Wisconsin, Idaho, Rhode Island, Vermont, Oregon. Here you will find states with low bike fatalities (Rhode Island and Vermont had none in 2014) and often high usage rates, Oregon being more than 5 times likely to bike than the median. Don't kid yourself. In the US, cycling can be safe and widely used. The existing data already shows it.

	Total Road Fatalities	Bicycle Mode share	Breakeven Point	Bicycle Fatalities	Excess Bicycle Deaths
Netherlands	621	27%	167.7	162	-5.7
Denmark	3,334	19%	633.5	835	201.5
Germany	3,377	10%	337.7	396	58.3
Austria	956	9%	86.0	80	-6.0
Belgium	724	8%	57.9	72.4	14.5
Sweden	264	7%	18.5	13.2	-5.3
Italy	3,381	5%	169.1	273	104.0
France	3,250	5%	162.5	130	-32.5
Great Britain	1,732	2%	34.6	113	78.4
United States	32,675	0.48%	158.1	726	568

Road Fatalities Per Inhabitant Index	
Sweden	26
United Kingdom	27
Netherlands	32
Denmark	33
Germany	41
Japan	44
France	48
Australia	51
Austria	51
Canada	57
Italy	58
Belgium	63
Europe	88
South Korea	98
United States	100
Mexico	116
Russia	178

As for the United States, there were 726 cycling fatalities in 2014. If cycling had been equally as safe as other modes, there would have been only 158 bicycle deaths nationwide. But as the above table shows, US excess bicycling deaths stood at 568. These were concentrated in the top five states, where 54% of the nation's cycling deaths happened (a total of 390), 327 of them being excess deaths. In the above we see that the same excess death analysis can be applied to other nations, such as the Netherlands, Austria, Sweden, and France where it appears that cycling trips were safer than those made by car. In these countries, their roads too were about twice to four times as safe as in the US, perhaps negative excess cycling deaths contributing to broader road safety.

By way of comparison, only fourteen US cities had usage rates as great as France. Delivering safety that reduces cycling deaths to a point beneath the breakeven point (where cycling trips are equally safe as a car trips) is seen as the most potent and effective form of advocacy. Once there, the great advantages of cycling become patently obvious to everyone.

Local Safety.

Much can be done easily. Safety, Speed, and Intersections are unavoidably linked.

Pulaski and other small low-population-density towns have vast advantages over cities plagued with traffic congestion. The huge efforts that cities must make for cycling are to counter the adverse consequences of high population density or excessively fast traffic. By contrast, with a few tweaks we small towns are ideal for cycling. We can most easily see small-town advantages via a thought experiment. Consider a sidewalk.

Time Available To React Reduced By Index Factor

Index of 1.00 equals extremely safe

Person #1	vs.	Person #2	Behind	Side	Head-On	Force of Head-On Impact
Walk 2.5 MPH		Walk 2.5 MPH	0.00	0.36	0.71	0.5
Walk 3.5 MPH		Walk 2.5 MPH	0.14	0.50	0.86	0.7
Walk 3.5 MPH		**Walk 3.5 MPH**	**0.00**	**0.50**	**1.00**	1.0
Jog 5.5 MPH		Walk 2.5 MPH	0.43	0.79	1.14	1.3
Safe Car 6 MPH		Walk 2.5 MPH	0.50	0.86	1.21	1.5
Jog 5.5 MPH		Walk 3.5 MPH	0.29	0.79	1.29	1.7
Safe Car 6 MPH		Walk 3.5 MPH	0.36	0.86	1.36	1.8
Jog 5.5 MPH		Jog 5.5 MPH	0.00	0.79	1.57	2.5
Tranquil Bike 9 MPH		Walk 2.5 MPH	0.93	1.29	1.64	2.7
Cautious Car 10 MPH		Walk 3.5 MPH	0.93	1.43	1.93	3.7
Tranquil Bike 9 MPH		**Safe Car 6 MPH**	**0.43**	**1.29**	**2.14**	4.6
Tranquil Bike 9 MPH		Tranquil Bike 9 MPH	0.00	1.29	2.57	6.6
Slow Car 15 MPH		Walk 3.5 MPH	1.64	2.14	2.64	7.0
Cautious Car 10 MPH		**Tranquil Bike 9 MPH**	**0.14**	**1.43**	**2.71**	**7.4**
Bike 15 MPH		Safe Car 6 MPH	1.29	2.14	3.00	9.0
Fast Bike 20 MPH		Walk 3.5 MPH	2.36	2.86	3.36	11
Slow Car 15 MPH		**Tranquil Bike 9 MPH**	**0.86**	**2.14**	**3.43**	12
Cautious Car 10 MPH		Bike 15 MPH	0.71	2.14	3.57	13
Fast Bike 20 MPH		Jog 5.5 MPH	2.07	2.86	3.64	13
City Car 25 MPH		Walk 2.5 MPH	3.21	3.57	3.93	15
City Car 25 MPH		Walk 3.5 MPH	3.07	3.57	4.07	17
Car 20 MPH		**Tranquil Bike 9 MPH**	**1.57**	**2.86**	**4.14**	17
City Car 25 MPH		Tranquil Bike 9 MPH	2.29	3.57	4.86	24
Car 20 MPH		**Bike 15 MPH**	**0.71**	**2.86**	**5.00**	25
City Car 25 MPH		**Bike 15 MPH**	**1.43**	**3.57**	**5.71**	33
City Car 25 MPH		Fast Bike 20 MPH	0.71	3.57	6.43	41
City Fast Car 35 MPH		**Bike 15 MPH**	**2.86**	**5.00**	**7.14**	51
Downhill Bike 25 MPH		City Car 25 MPH	0.00	3.57	7.14	51
Rural Car 55 MPH		**Tranquil Bike 9 MPH**	**6.57**	**7.86**	**9.14**	84
Rural Car 45 MPH		Fast Bike 20 MPH	3.57	6.43	9.29	86
Fast Car 60 MPH		Tranquil Bike 9 MPH	7.29	8.57	9.86	97
Rural Car 55 MPH		**Bike 15 MPH**	**5.71**	**7.86**	**10.00**	100
Fast Car 60 MPH		Bike 15 MPH	6.43	8.57	10.71	115
Rural Car 55 MPH		Downhill Bike 25 MP	4.29	7.86	11.43	131
Fast Car 60 MPH		Rural Car 55 MPH	0.71	8.57	16.43	270
Fast Car 60 MPH		Fast Car 60 MPH	0.00	8.57	17.14	294

The index in this table equals in each case the closing speed divided by the seemingly safe sidewalk closing speed of 7 MPH. A physics note: force is to the square of the velocity.

On the human scale, people on a sidewalk are remarkably good at avoiding collisions with each other. On a sidewalk, it is vanishingly rare that a person bumps into someone else: either head-on, from the side, or from the rear. This seemingly obvious observation tells us a great deal about appropriate speeds for interacting with bicycles and pedestrians.

On a sidewalk, we usually gauge others exceptionally well. Although we may come very close on occasion, we do not collide. This is mainly due to closing speeds. When people are walking at 3.5 MPH in opposite directions, the worst possible case would be that they would hit head-on at a closing speed of 7 MPH. This seems not to happen because people are wired sufficiently well to reliably avoid collision at this speed.

Higher speeds, however, increase complexity to a point that it impossible to respond appropriately. To make it worse, severity of accident increases with speed.

Though car-bike accidents are obviously attributable to many components other than closing speed, the following table is intended to illustrate the difficulty of avoiding collisions relative to the apparently safe 7 MPH sidewalk closing speed that all of us seem to be able to handle. At a first guess, an index of 2.00 might seem acceptably safe given that many of us regularly accept other more dangerous scenarios. That guess would be wrong.

Percent	Ratio	MAIS classification of injury severity
0.5%	219	MAIS 0
71.9%	1.4	MAIS 1 Minor, e.g., superficial laceration
21.2%	5	MAIS 2 Moderate, e.g., fractured sternum
3.7%	27	MAIS 3+ (but not fatal) Serious, e.g., open fracture of humerus or worse
1.6%	63	Fatal
1.1%	88	Unknown

We can see consequences and causes of car-bike collisions in *A Study of Bicycle and Passenger Car Collisions Based on Insurance Claims Data*. The seriousness of injury in the 438 cases studied addresses key car-bike accident fears, as shown in this table. Which is to say, 26% of the car-bike accident cases (MAIS2+) were considerably worse than minor lacerations, one out of 19 being very serious (MAIS3+), one out of 63 being fatal. The average impact speed to produce these levels of injury was a mere 11.8 MPH (corresponding to a 1.69

reduced time to react time in the table to the left). And in 68% of the cases the impact speed would have been less than 23.1 MPH (a 3.29 decision time reduction factor in the table). The speed range between the two points is illustrated by red. Half occurred at impact speeds of 7.8 MPH or slower (1.11 in the table). Those collisions occurring at levels higher than marked in red should be considered exceptionally serious. In the table the impact speed when hit from the side is calculated at the speed of Person #1.

Our little sidewalk exercise when coupled with the insurance study seems to suggest that even when our decision time is cut short by low multiples, such as 1.11 or 1.6, we are vulnerable to car-bike accidents, which in about 26% of cases are apt to be far worse than minor lacerations. It also suggests that intersections create a degree of complexity and risk far exceeding common meandering on sidewalks that we are well adapted for. A key takeaway is the importance of reducing speed, especially at intersections, to reduce severity and likelihood of accident. In low-density small towns this safety producing point blends nicely with neighborhood greenways and is apt to be safety producing. More complex infrastructure may well be counterproductive.

76.7% of all the car-bike collisions in the study occurred at intersections. Of these 50.9% were on roads that included a bicycle lane; 25.9%, on roads without bike lanes. To increase safety, primary focus needs to be on countermeasures to prevent or mitigate collisions at intersections. Speed is a key factor there.

In the US, protected bike lanes are often proposed purporting safety. Even if this were so, their lengths, shown in the page 15 table, tend to be too short in most states to significantly influence bike fatality rates. Sixty percent (172 miles) of the nation's protected bike lane total length (285 miles) are in the top five states with highest excess deaths. In huge cities like New York and Chicago, delivery vehicles, double parked cars, cabs discharging passengers, and so forth block traditional bike lanes to the extent that they tend to be ineffective. Protected bike lanes provide a good alternative to these problems, but we need to apply a bit of scrutiny if they are being proposed for purposes of safety in lower populated areas.

Clawing our way back.

You may ask how bikes fit into economic development. I suggest looking at Pulaski as if its current population of 8,890 were facing historically experienced growth rates. In the shown years, population would have changed in the town of Pulaski at the indicated average rate. In the following table those growth rates are applied to its current 8,890 population base.

Year	Annual Percent Change	Annual change in number of people in Pulaski	Monthly change
1890-1900	2.9%	259	22
1900-1910	5.5%	489	41
1910-1920	0.9%	84	7
1920-1930	3.1%	276	23
1930-1940	2.1%	184	15
1940-1950	**0.5%**	**41**	**3**
1950-1960	1.3%	116	10
1960-1970	-0.2%	-16	-1
1970-1980	-0.2%	-15	-1
1980-1990	-0.1%	-11	-1
1990-2000	-0.5%	-46	-4
2000-2010	-0.4%	-37	-3
2010-2015	-0.4%	-39	-3

Up until 1960 the town's population change was positive, in some years booming. Then it went into a slow decline which accelerated during roughly the past three decades. Economic development efforts during the past three decades were insufficient and we lost roughly 40 people per year, even in years when national GDP growth was strong.

Pulaski's decline can be arrested by clawing our way back, person by person. This town has unusually great attributes. Its singular crime is that we have failed to develop them. Bring in 40 people a year and decline stops. Bikes may or may not be dramatic, but they certainly will help stem the decline. Similarly, more often than not, success is incremental not dramatic.

	Pulaski	Wytheville	Dublin	Hillsville	Radford	Christians-burg	Blacks-burg	Min	Median	Average	Max	Pulaski to Median	Pulaski to Average
1890-1900	2.9%	1.6%			5.0%	-0.8%	0.5%	-0.8%	1.6%	1.8%	5.0%	**1.3%**	**1.1%**
1900-1910	5.5%	0.2%	1.0%		2.3%	9.1%	1.3%	0.2%	1.8%	3.2%	9.1%	**3.7%**	**2.3%**
1910-1920	0.9%	-0.4%	1.2%		1.0%	0.5%	2.3%	-0.4%	1.0%	0.9%	2.3%	**0.0%**	**0.0%**
1920-1930	3.1%	1.2%	1.2%		3.0%	1.8%	2.5%	1.2%	2.2%	2.1%	3.1%	**0.9%**	**1.0%**
1930-1940	2.1%	3.4%	2.7%	3.1%	1.2%	1.6%	4.3%	1.2%	2.7%	2.6%	4.3%	**-0.6%**	**-0.5%**
1940-1950	0.5%	1.7%	8.6%	1.5%	2.6%	2.6%	4.6%	**0.5%**	2.6%	3.2%	8.6%	-2.1%	-2.7%
1950-1960	1.3%	0.2%	0.8%	1.7%	0.4%	2.1%	7.7%	0.2%	1.3%	2.0%	7.7%	**0.0%**	**-0.7%**
1960-1970	-0.2%	0.7%	1.5%	2.4%	2.1%	8.0%	2.9%	-0.2%	2.1%	2.5%	8.0%	-2.3%	-2.7%
1970-1980	-0.2%	1.6%	3.7%	6.3%	1.3%	2.8%	12.6%	-0.2%	2.8%	4.0%	12.6%	-3.0%	-4.2%
1980-1990	-0.1%	1.2%	-1.6%	-0.6%	1.9%	3.8%	1.2%	-1.6%	1.2%	0.8%	3.8%	-1.3%	-0.9%
1990-2000	-0.5%	-0.3%	1.3%	2.6%	-0.1%	1.2%	1.4%	-0.5%	1.2%	0.8%	2.6%	-1.7%	-1.3%
2000-2010	-0.4%	0.5%	1.0%	0.3%	0.3%	2.2%	0.7%	-0.4%	0.5%	0.7%	2.2%	-0.9%	-1.1%
2010-2015	-0.4%	-0.2%	1.2%	0.0%	1.2%	0.8%	0.7%	-0.4%	0.7%	0.5%	1.2%	-1.2%	-0.9%
1960-2015	-15%	**44%**	**88%**	**196%**	**86%**	**501%**	**525%**	-15%	**88%**	**204%**	**525%**	-103%	-219%
1960-2015	-1,579	**2,481**	**1,259**	**1,772**	**8,032**	**18,290**	**37,145**	-1,579	**2,481**	**9,629**	**37,145**	-4,060	-11,208

People are voting with their feet and going elsewhere. Look at Pulaski's annual population change relative to other nearby towns. In years marked in red Pulaski's performance was especially poor. From 1960 on, whether you compare Pulaski's population change to the Median or to the Average for the group, it was far below acceptable standards. It is the only town in the group with a consistently downward trend. In many of these years it was the worst of the group. Since 1960, 1,580 fewer people are here, a 15% fall in population. By contrast, in the same period every other town on the list has grown by considerably more than 1,200 people. This should not be happening. I ask you what fixes has Pulaski put in place?

If here in Pulaski, we, without distinction, do roughly the same as towns and cities elsewhere have done for decades (more of the same perhaps just better): Where is the sparkle of interest that will bring people here rather than their going elsewhere? Where is the diversity? Where is the excellence? Where are new drawing points to give the town luster and success?

Consider the recently graduated university student who bikes daily and is now moving into full time employment. Will he or she give up the pleasure and practicality of biking to come to a Pulaski that has so little biking infrastructure that it would compel him or her to give up a principal pleasure? Think long and hard.

At the end of the day a sharrow is just paint on the road. If it does not produce the claimed results, no harm, no foul; replace it. The investment was tiny. The position here, however, is that there are a vast number of solid reasons to expect the Loop to be hugely successful – an attraction that brings and holds people.

Compare the Pulaski Loop with Blacksburg's recently added sharrows: 1) Blacksburg's sharrows are not on the "Harvard Plan" (they lack the advisory markings and stencil markings are placed far apart, for example, 90 ft on Drillfield, 215 ft on Progress, 340 ft on Draper Road); 2) they do not have yield to bicycles in sharrow signs; 3) they are discontinuous sections, not a continuous five mile loop (eg. Progress Street, Giles Road, Draper Road, and Drillfield); and 4) they are on small roads, not on four lane roads leading to the majority of the town's retail sector.

I believe you will find that when VT folks visit us they will be impressed and pass the word on about the good work done in Pulaski. In sum, it is well within Pulaski's capabilities to be a standout, an attraction, newsworthy, and a desirable place to live.

Public-Private partnership.

Consider again those "32 dual signs, stencils, paint, and labor" for the Pulaski Loop. Such a program is vastly different from heavy equipment required in most infrastructure projects. In short, notwithstanding that the Loop is a massive project, it can be accomplished step by step by people with ordinary skills. Bike enthusiasts, students, and other volunteers can get important work done. This is not only of practical benefit to the town, it instills pride and a sense of ownership for having completed a bicycle project that can be transformative for the community.

It also gives cycling greater status and sense of personal connection to the community than can be achieved by other means. The sense of "I built that" lasts forever. It is something your kids will see. They will remember your role in it.

If the Town can supply one or two people from the town shop to work with volunteers once a week, it would help move the project forward. It also would create a sense of respect for Town workers. I have worked with these guys. They are a fine bunch. It would be nice if others, by personal experience, knew this also.

The project can be funded in part by private donations. It would help if the Town can establish a tax deductible entity and audited account to handle receipts and expenditures for the bike project. I am prepared to deposit $3,000 now in a Town account towards purchasing the designated 32 dual signs for the "Harvard Plan" sharrow loop. Many of us make philanthropic donations. Having donations spent close to home and with no overhead management costs, makes such contributions highly appealing. The million dollar contribution to the Huckleberry Trail is evidence of this. Here in Pulaski, large and small contributions alike would seem central in our project. By way of comparison, this $3,000 starting offer is one third of what the city of Raleigh gleaned from its total crowdfunding campaign for bicycle infrastructure.

As for the sharrows vs. bike lanes discussion, well-known bicycle book author, Robert Hurst [p. 94] makes the point that, "***bike lanes are obsolete.*** The transportation planner who still thinks in terms of lanes is a dinosaur. … A new surface treatment is proliferating that carries most of the advantages of bike lanes without the controversial disadvantages. The sharrow. … It clearly signals that the bicyclist's place is in the street …, but doesn't keep the bicyclist confined to an area of the street where he can be most vulnerable, the sharrow is the new best in class among surface treatments for bicyclists."

In short, the Pulaski Loop with its "Harvard Plan" sharrows offers huge returns for tiny efforts. By contrast, grant proposals are "stringy" and require much time and expense to execute and put in practice, I hope the "money in your lap" and community involvement of a Public-Private partnership will serve the Town well.

Most importantly, what is proposed here are real results, not just feel-good, "we-have-done-something-for-cycling" assertions that often accompany an ill-conceived bike lane stuck somewhere within a jurisdiction.

Process

It seems that establishing a procedure in advance would be helpful to avoid people stepping on someone else's toes and so folks work together rather than in opposition.

As to the sharrow loop discussed here, if it is to be seriously considered by Town Council, it seems all of us together (interested people, Town administration, and Town Council Members) need to give it thorough study. At present it is in rough form, not yet suitable for making decisions. We need to draw on a wide variety of viewpoints, and we need to know more.

There is also a need to make thorough drawings indicating what's to be done where, otherwise we risk drowning in speculative chatter. It would seem appropriate to keep working groups open, so that interested parties can not only participate, but are explicitly and publicly invited and urged to participate.

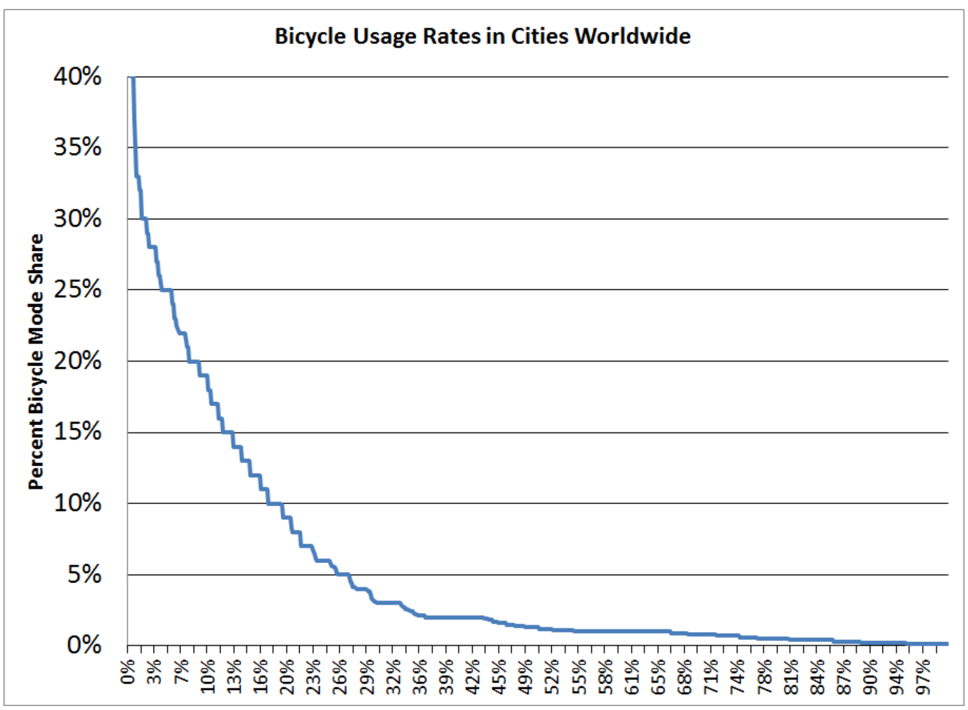
Public Hearings on the Pulaski Bike Loop can be held when all of us are well informed. NO NEED to hurry the process. Better to get it right. Once the kinks are ironed out, then a formal proposal can be made to Town Council.

Like the bike? A few remarks.

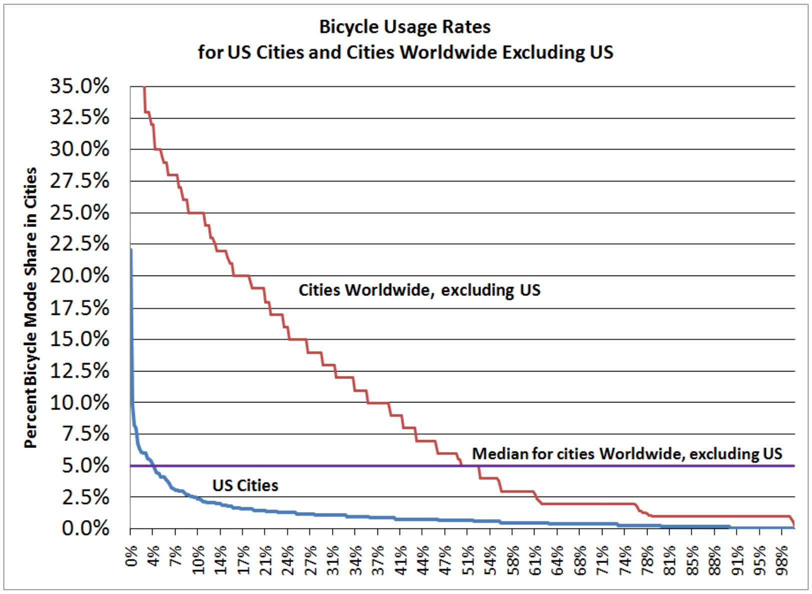
Bikes are fun, useful, and more. They are used only occasionally.

From the data it becomes clear that worldwide, about one of 12 bikes owned are actively used for commuting. In the US, it's one in a hundred. As you see in the graph, only 20% of cities in a sample of 680 cities worldwide used bicycles in 8% or more of trips. On the flip side, only 8% of the cities used them for 20% or more of trips.

Percent of Cities	Numeric Rank	Usage Rate
0.1%	1	55%
0.3%	2	44%
0.4%	3	43%
0.6%	4	40%
1.0%	7	37%
1.2%	8	33%
1.5%	10	33%
1.9%	13	30%
2.5%	17	29%
3%	19	28%
4%	25	27%
4%	27	26%
4%	29	25%
6%	38	24%
6%	40	23%
6%	44	22%
7%	50	21%
8%	52	20%
9%	61	19%
10%	68	18%
10%	71	17%
11%	77	16%
12%	80	15%
13%	89	14%
15%	103	12%
16%	112	11%
17%	118	10%
19%	130	9%
20%	138	8%
21%	145	7%
24%	162	6%
24%	163	6%
26%	176	5%
28%	191	4%
30%	208	3%
36%	248	2%
46%	316	2%
55%	372	1%
72%	490	0.7%
77%	524	0.5%
89%	610	0.2%
100%	682	0.1%
World (Exclude US) Median		5.0%
World (Exclude US) Average		9.6%
USA Median		0.70%
USA Average		1.15%
World/USA Ratio at Median		7.1
World/USA Ratio at Average		8.3
World-USA at Median		4.30%
World-USA at Average		8.43%



There are few things that give as much lasting pleasure and contentment as a bike ride. Yet, I too use my car more than my bike, even when I could just as readily use the bike. Here we have said much about road safety, good ways to integrate bikes into street trips, and so forth. In doing so, we have given bikes themselves a pass as if they were perfectly suited for the task. Well that is not the case. And that is why I think bike designers and manufacturers like myself need to deliver significantly better bikes than are now available.



Only 14 US cities have usage rates greater than 5%. Yet, 5% is the median for non-US cities in this sample. On a playing field like this, better is not hard.