T-MAP: From Niche to Norm

A Practitioner-Rooted Research Project

Keith Laughlin
President, Rails-to-Trails Conservancy
Active Living Research Conference
March 8, 2014

My Role on the Panel

To create advocacy context for the research to follow

RTC 101

- Founded in 1986
- 150,000 Members and supporters
- HQ in DC with 4 Regional Offices
- 40+ Staff

rails-to-trails conservancy

Our Mission

"To create a nationwide network of trails from former rail lines and connecting corridors…

…to build healthier places for healthier people."

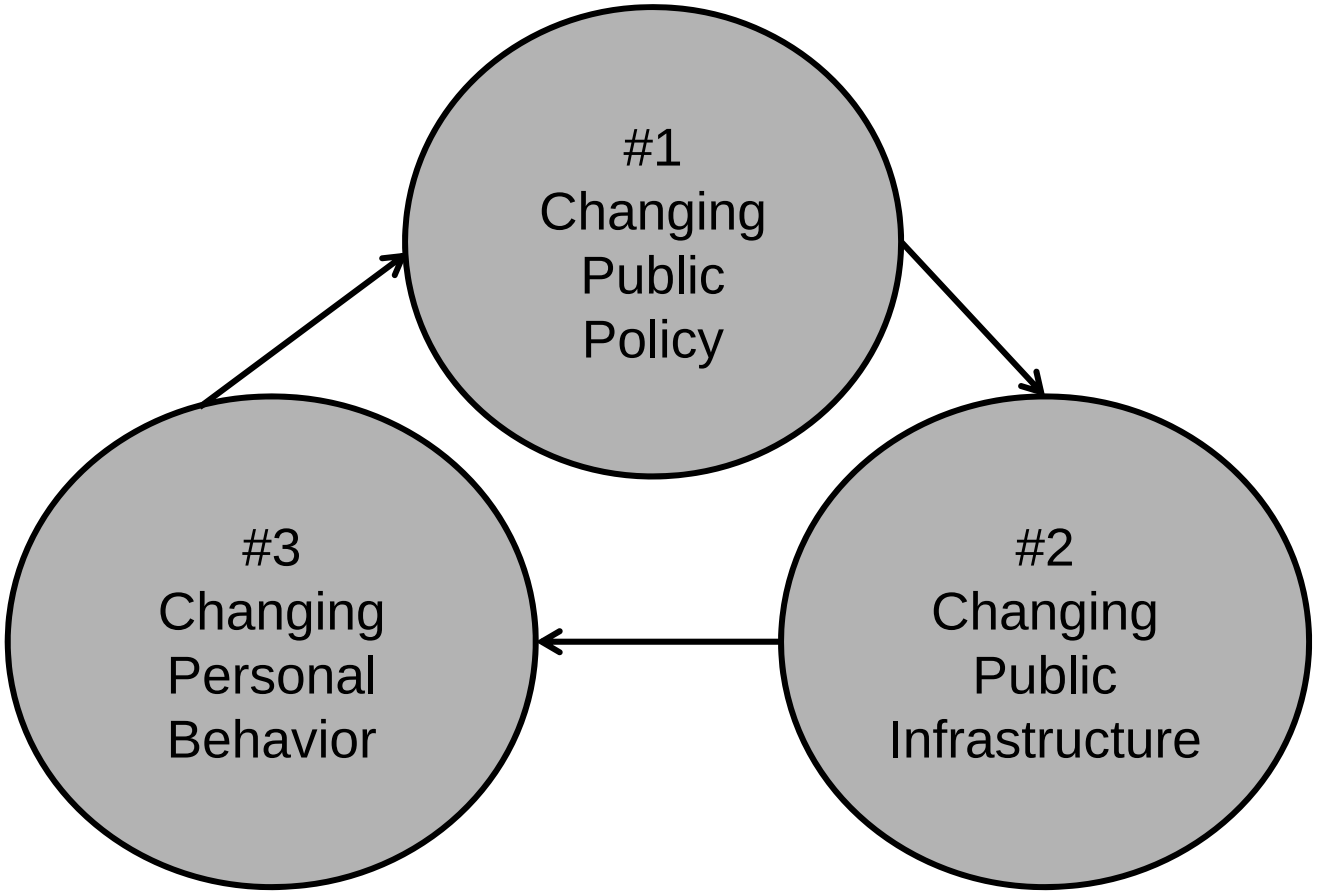
- Adopted Oct 2004

“Health” in Multiple Dimensions

Improving the…

- …***economic and environmental health*** of a place
- …***personal health*** of its people
- …***social health*** of a community

Our Methods:
Catalyzing Change in 3 Spheres



Our Methods:
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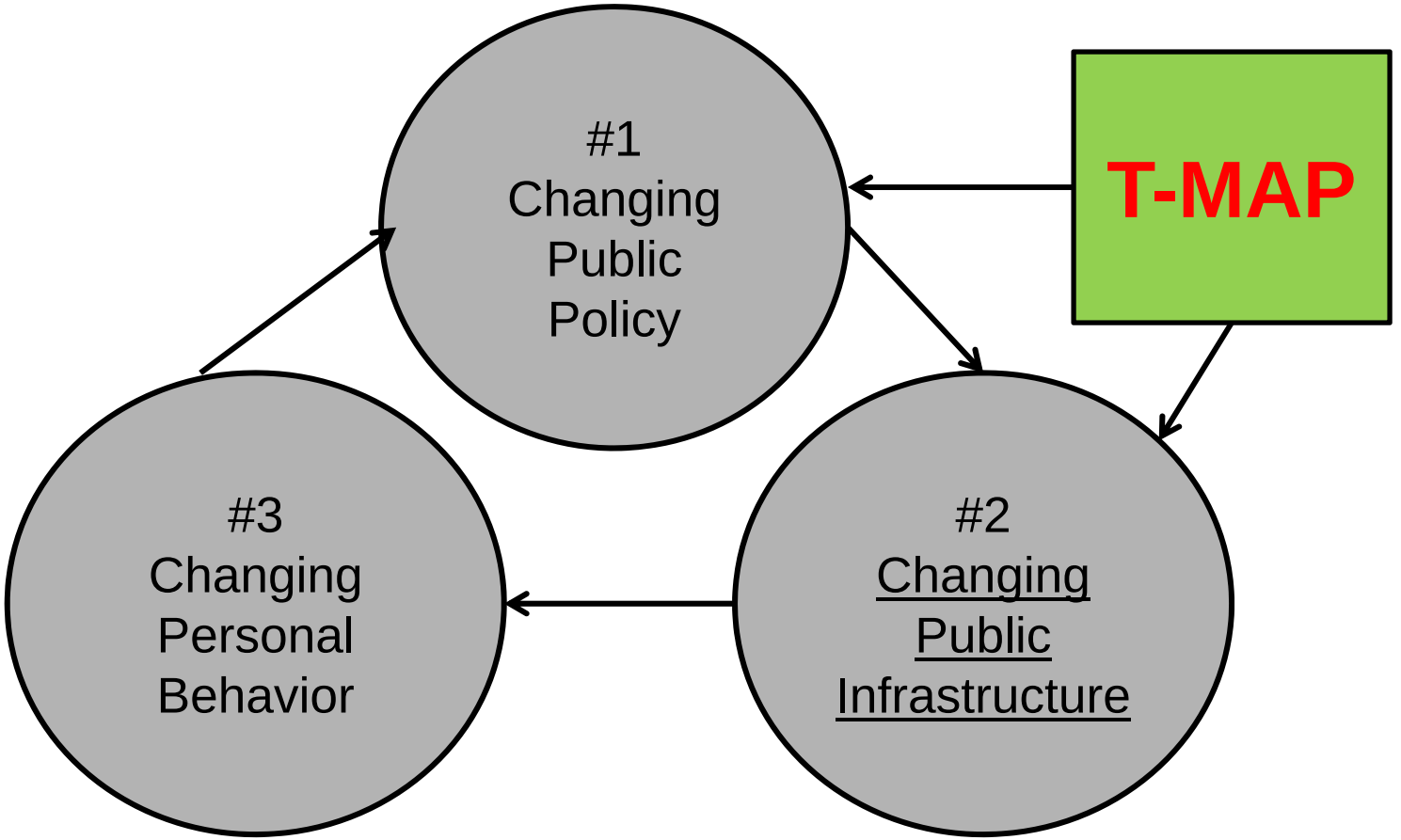

Shameless Plug: Sphere #1: Changing Policy

Safe Routes Everywhere_FINAL_low res_011514.pdf - Adobe Reader

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Partnership for
Active Transportation

Safe Routes to Everywhere

Building Healthy Places for Healthy People Through Active Transportation Networks




Looking Back

Past success:

- 1986: 250 miles
- 2014: >21,000 miles

Looking Ahead: Our BHAG

<u>Our Big, Hairy, Audacious Goal:</u>

By 2020, 90 percent of Americans will live within three miles of a local trail system.

Measuring the BHAG: Creating Geospatial Data Base

- Since 2006 we have mapped 25,500 miles of multi-purpose trail in the US
- Overlay with Census data to measure proximity

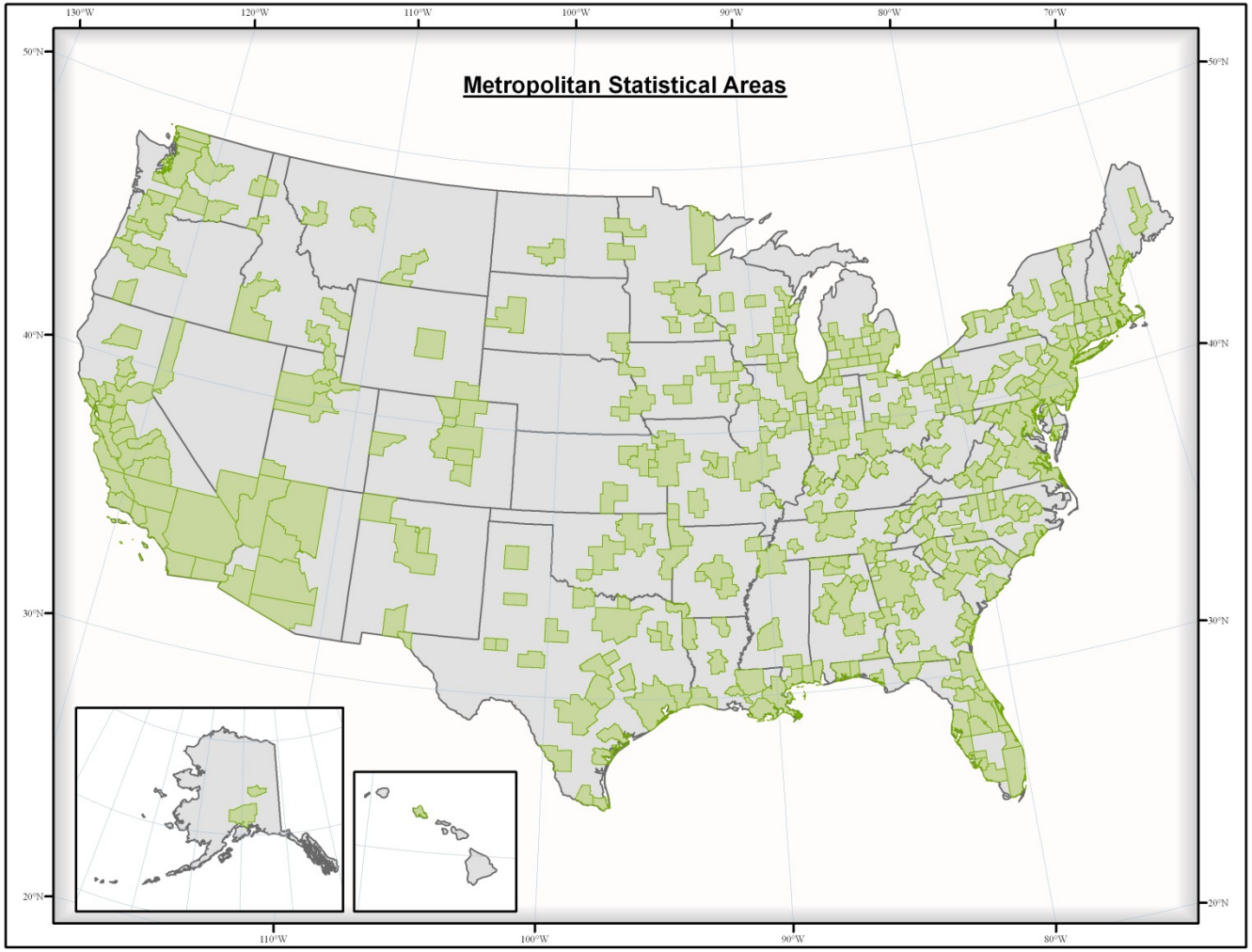
National Progress on BHAG

- Dec. 2009: 25.5%
  - 14,700 miles of trail
- Dec. 2010: 32.5%
  - 17,500 miles of trail
- Dec. 2011: 39.8%
  - 21,700 miles of trail
- Dec. 2012: 42.2%
  - 23,500 miles of trail
- Dec. 2013: 44.0%
  - 25,200 miles of trail

State-Level Analysis: 2013

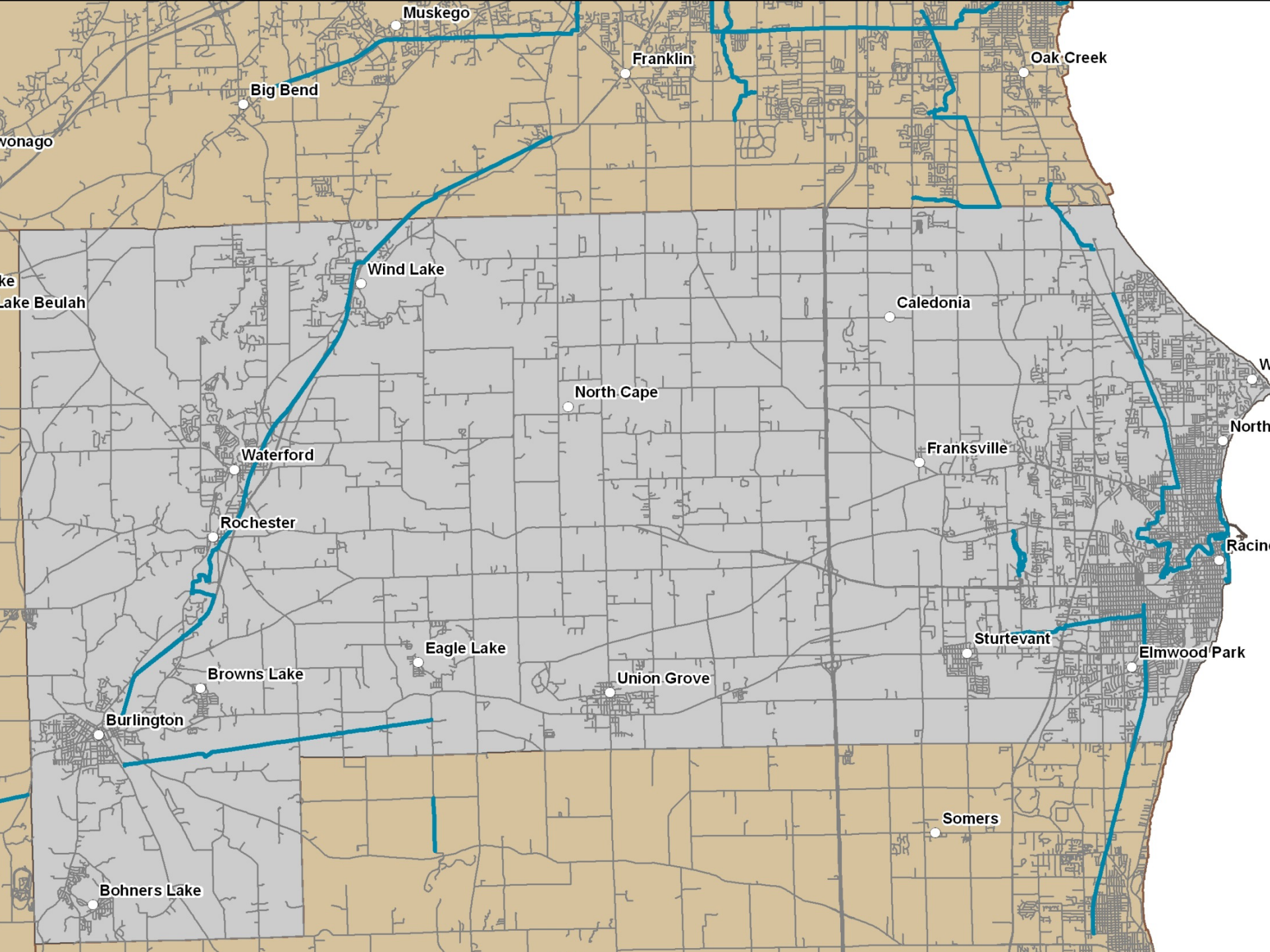
1. District of Columbia (100%)
2. Rhode Island (75%)
3. Colorado (70%)
4. Washington (68%)
5. Illinois (66%)
6. California (62%)
7. New York (58%)
8. Nebraska (58%)
9. Oregon (58%)
10. Wisconsin (56%)

MSA-Level Analysis



MSA-Level Analysis

1. Rockford, IL (93%)
2. San Francisco-Oakland-Fremont, CA (92%)
3. San Jose-Sunnyvale-Santa Clara, CA (92%)
4. Boulder, CO (91%)
5. Lincoln, NE (90%)
6. **Racine, WI (90%)**
7. **Milwaukee-Waukesha-West Allis, WI (90%)**
8. Denver-Aurora-Broomfield, CO (88%)
9. Des Moines-West Des Moines, IA (85%)
10. Fort Collins-Loveland, CO (85%)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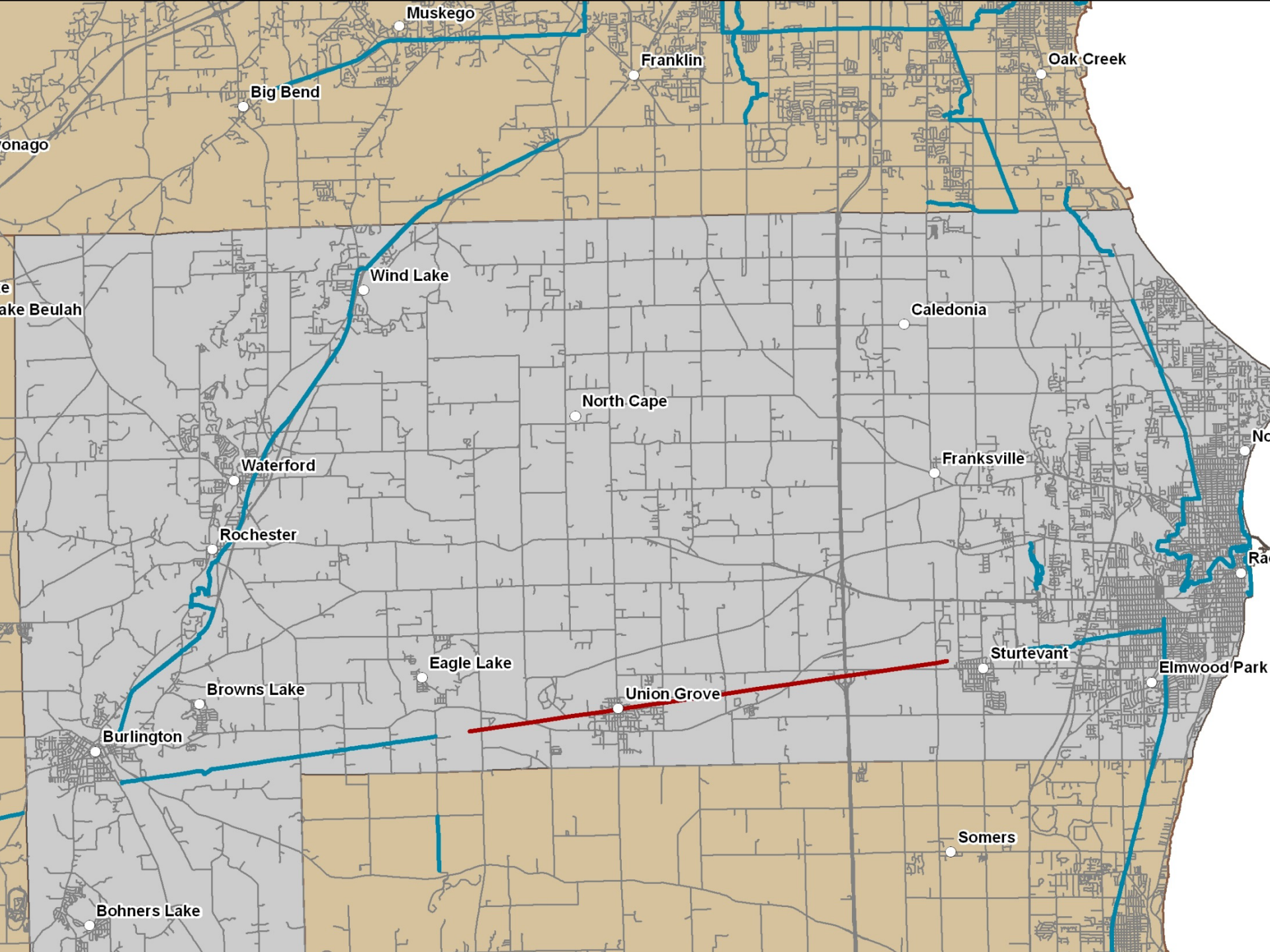
Lake Beulah
Caledonia
North Cape
Waterford
Franksville
Rochester
Racin
Eagle Lake
Sturtevant
Elmwood Park
Browns Lake
Union Grove
Burlington
Somers
Bohners Lake

RTC's Early Warning System

- On January 28, 2014, the Soo Line filed a notice to abandon 10.6 miles of active line between Sturtevant and Kansasville, WI.
- We notified all potentially interested parties in Wisconsin
- Wisconsin state DNR intends to rail bank this segment
- The map now looks like this…


Muskego
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Inescapable Conclusion

- Measuring proximity is useful, but limited
- It does not address equity
- It does not ensure usage
- Accessibility and connectivity are crucial factors in determining if infrastructure change supports behavior change
- **Key Question:** Does infrastructure effectively connect people and places?

The Genesis of T-MAP

- Was NOT created to develop “evidence”
- Emerged last summer from a dialogue with Tracy about creating “TrailScore” to measure trail system connectivity
- I want practical tools to change the world
- Tracy, Greg & Michael want to do rigorous cutting edge peer reviewed research that will change the world

Conclusion: The Opportunity

- $7 billion in federal investment since 1991 has built 25,000 miles of multi-purpose trails across the American landscape
- Approaching a tipping point: relatively small investments to make connections to create networks will cause usage to soar
- T-MAP will ensure and demonstrate that future investment delivers a high ROI

Questions?

rails-to-trails conservancy

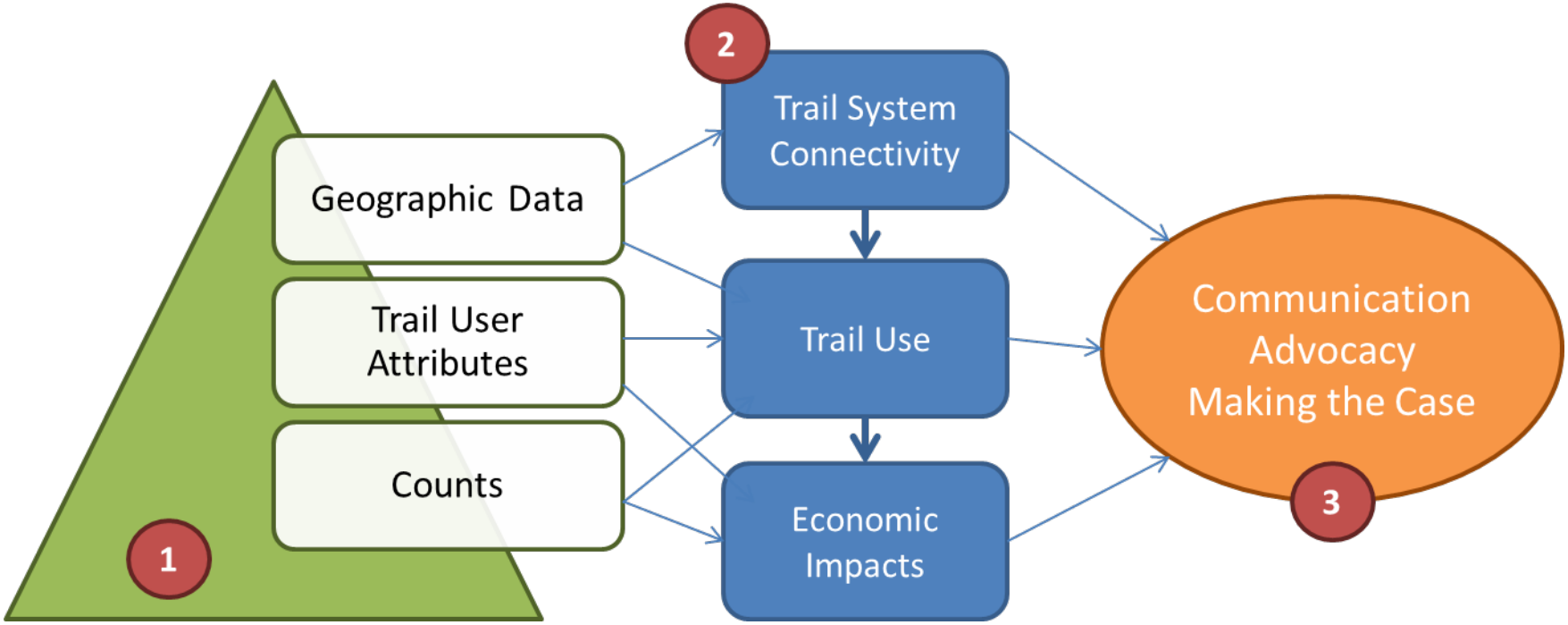
rails-to-trails conservancy

T-MAP
Research Design

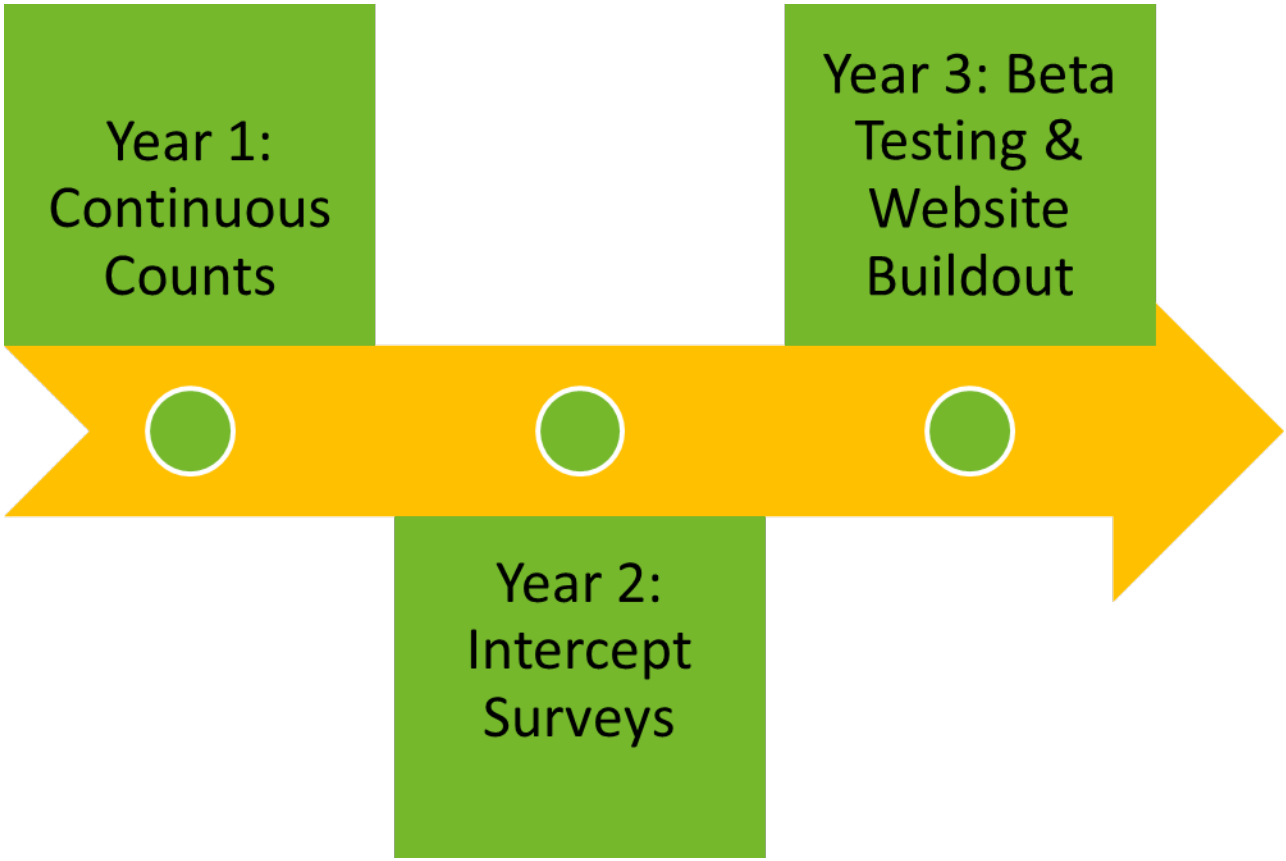
Tracy Hadden Loh, Ph.D.
Active Living Research

3/9/14

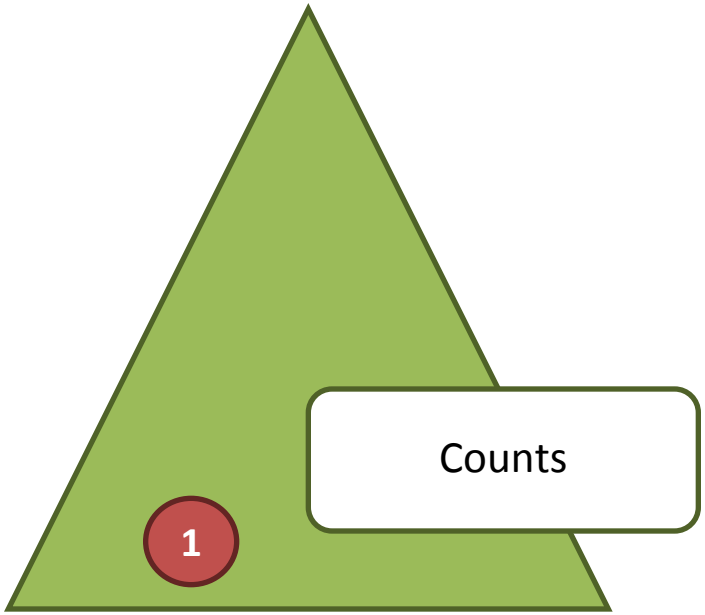
T-MAP by Component



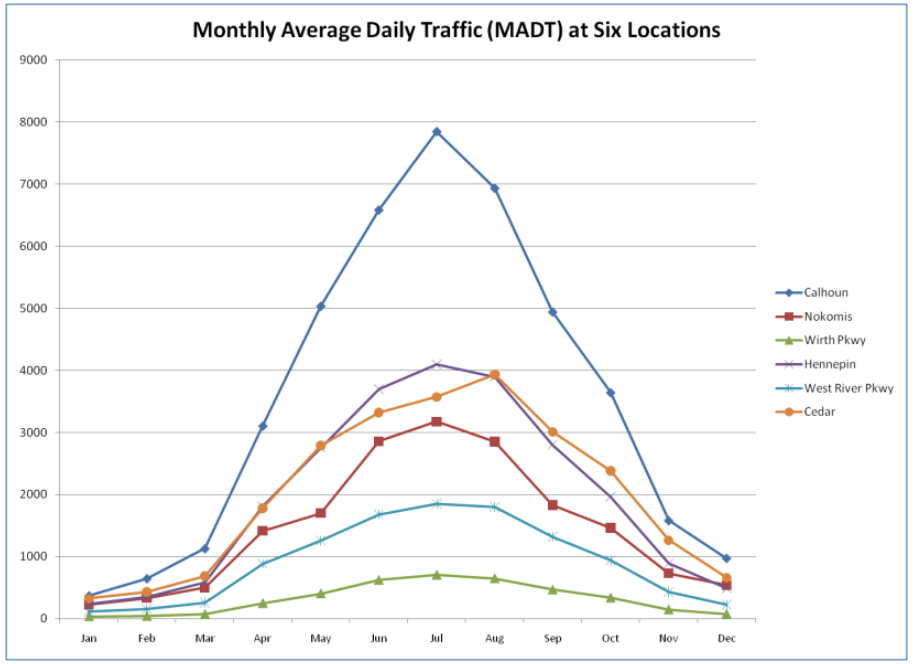
Timeline


Year 1: Continuous Counts
Year 2: Intercept Surveys
Year 3: Beta Testing & Website Buildout

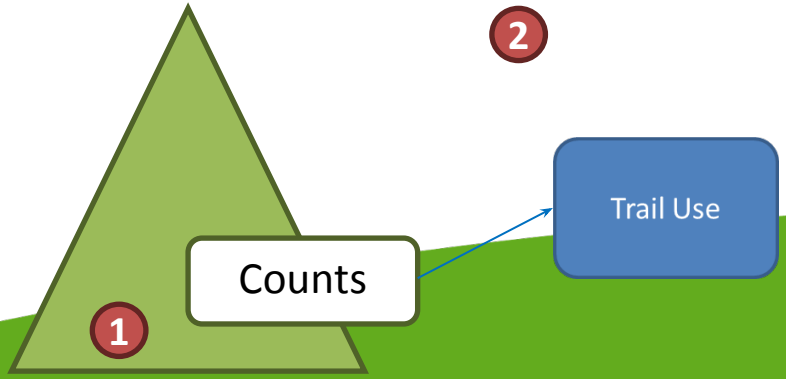
Year One Data Collection: Counts



Trail Use Research Questions

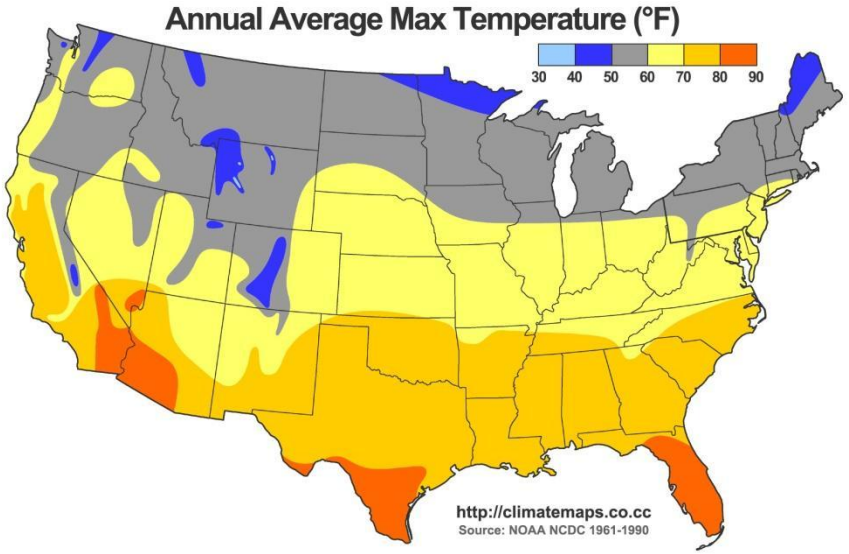


- How many visits does my trail get per year?
- What is the peak trail use on my facility?
- What is the modal distribution of my users?

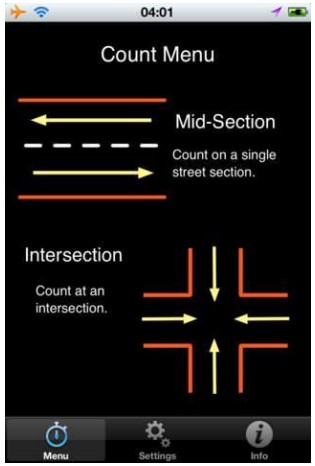


Year One Deliverables: Factors

- Separate for bicyclists and pedestrians
- For all weather zones of the US
- Large sample



Year One Deliverables: Calculator



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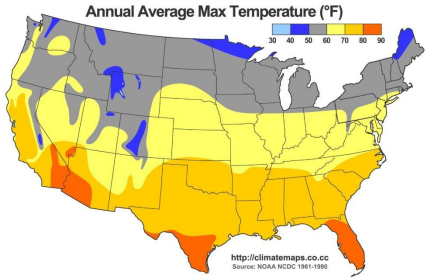

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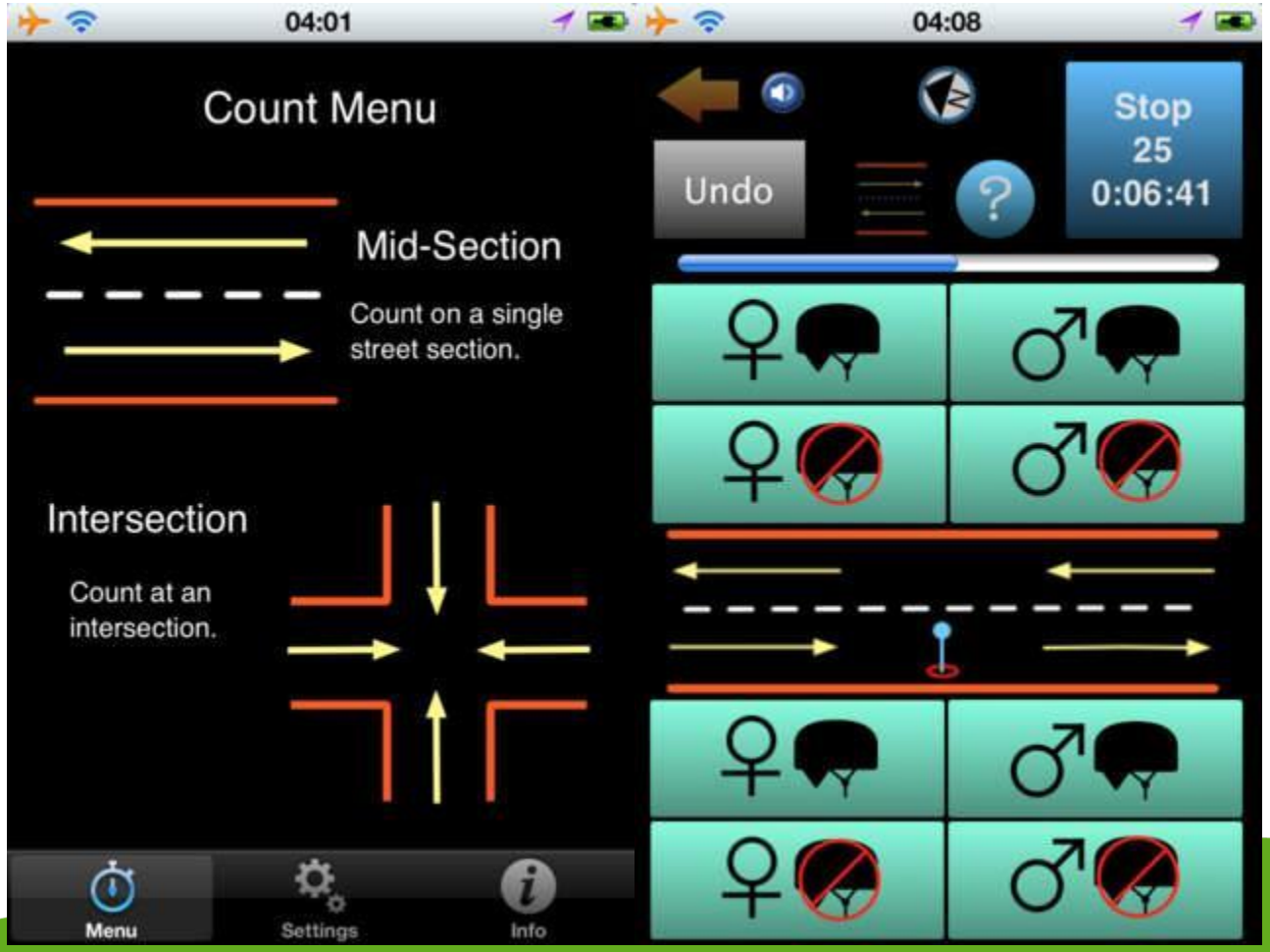
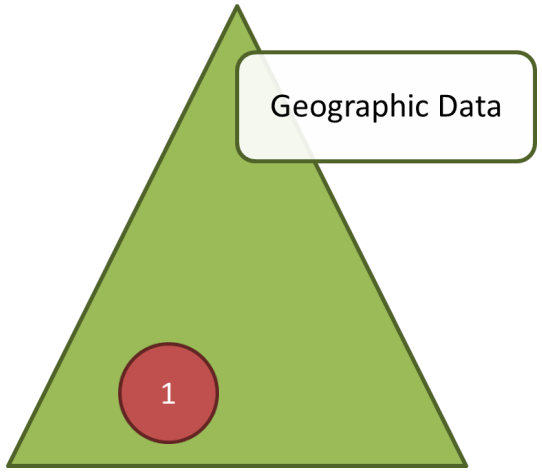
TrailLink
by Rails-to-Trails Conservancy

Year One Deliverables: RTCounts!



Year One Data Collection: Trail GIS

- Time of year (season)
- Weather
- How many people live nearby
- Nearby destinations
- Trail width
- Trail surface
- Trail cleanliness
- Etc

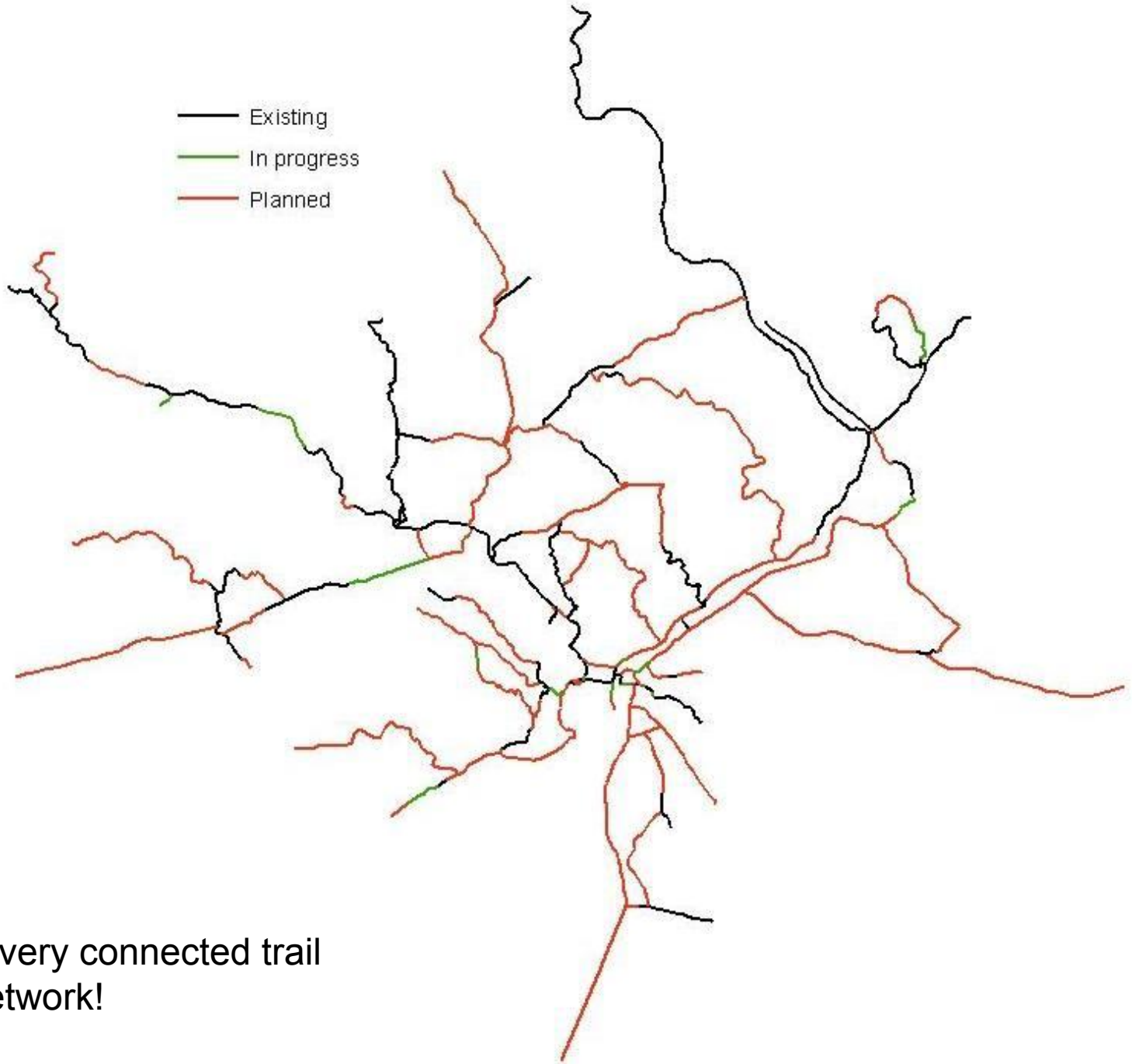


Trail GIS Research Questions

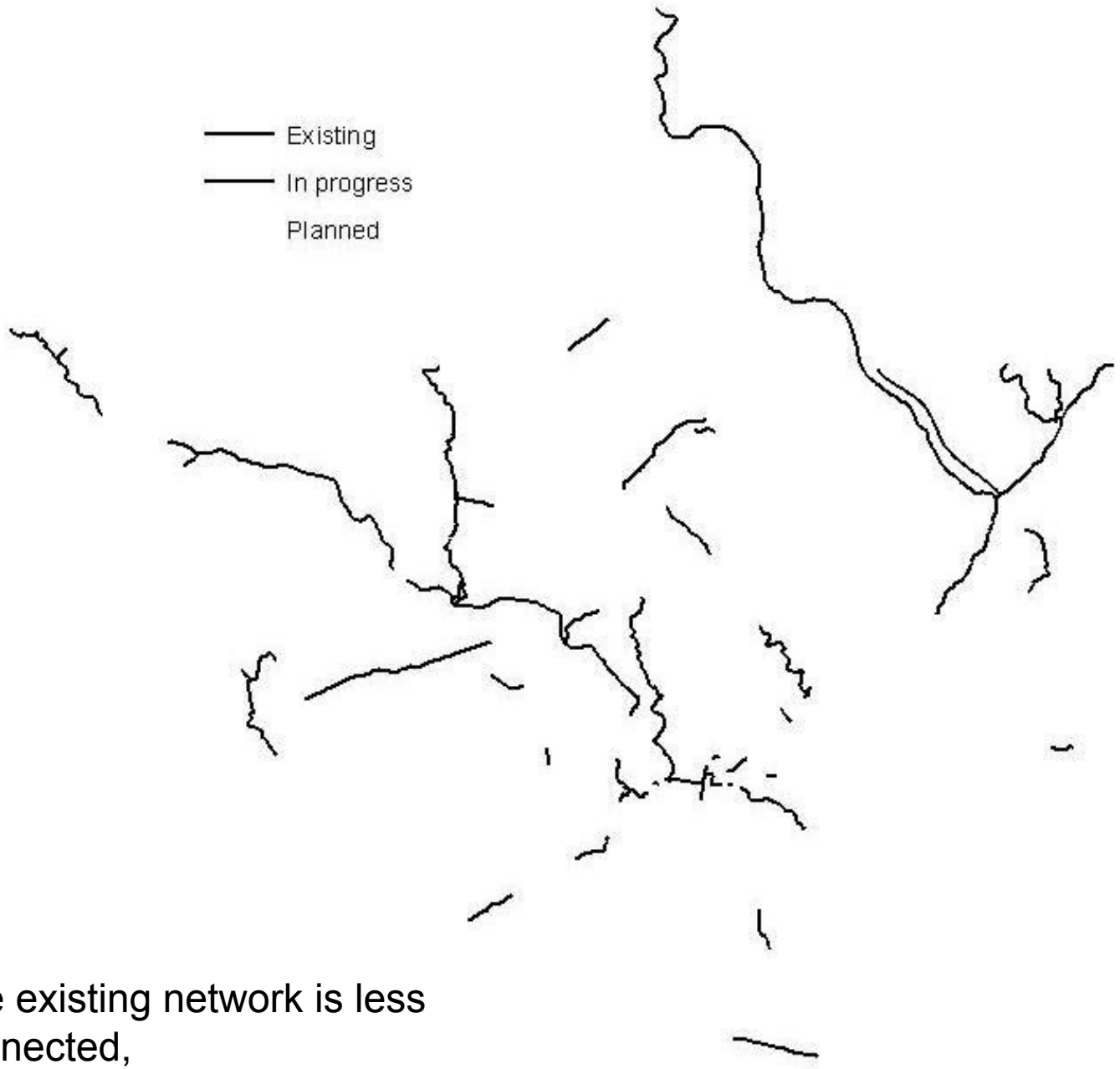
- Which trail segment should we build next?
- What are our goals for the trail system – who and what do we want to connect?
- How can we compare potential segments as apples?
- How good a job does the trail network do of connecting origins and destinations?

Year One Deliverables: Trail System Connectivity

- Unit of analysis is the community level
- Same method, multiple possible applications
  - Developing the method is pure research work
  - Incorporating the tool into practice is a bigger task

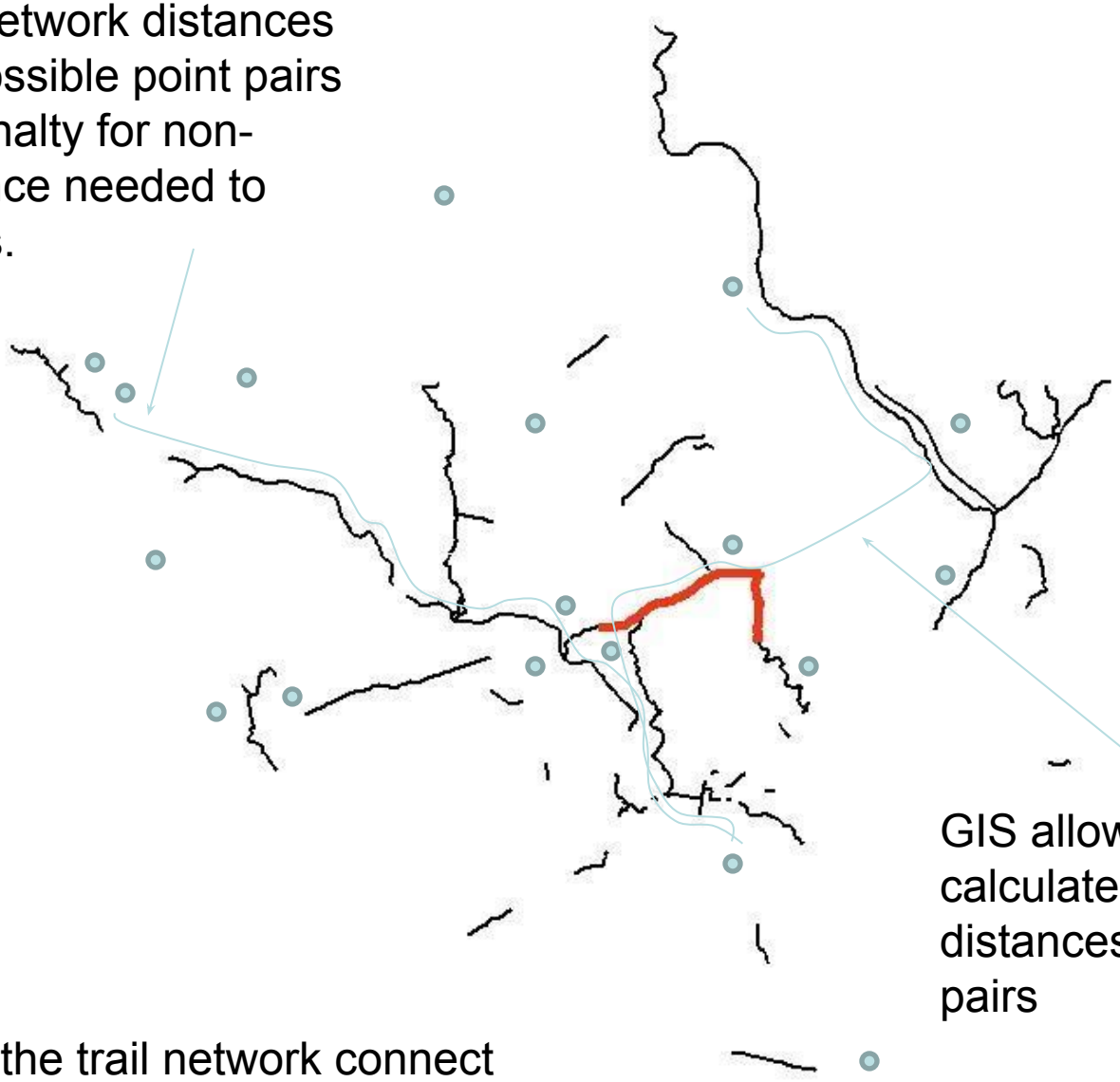


A very connected trail network!



The existing network is less connected,
naturally

Measure with a statistic that is a function of network distances between all possible point pairs – an add a penalty for non-network distance needed to connect points.

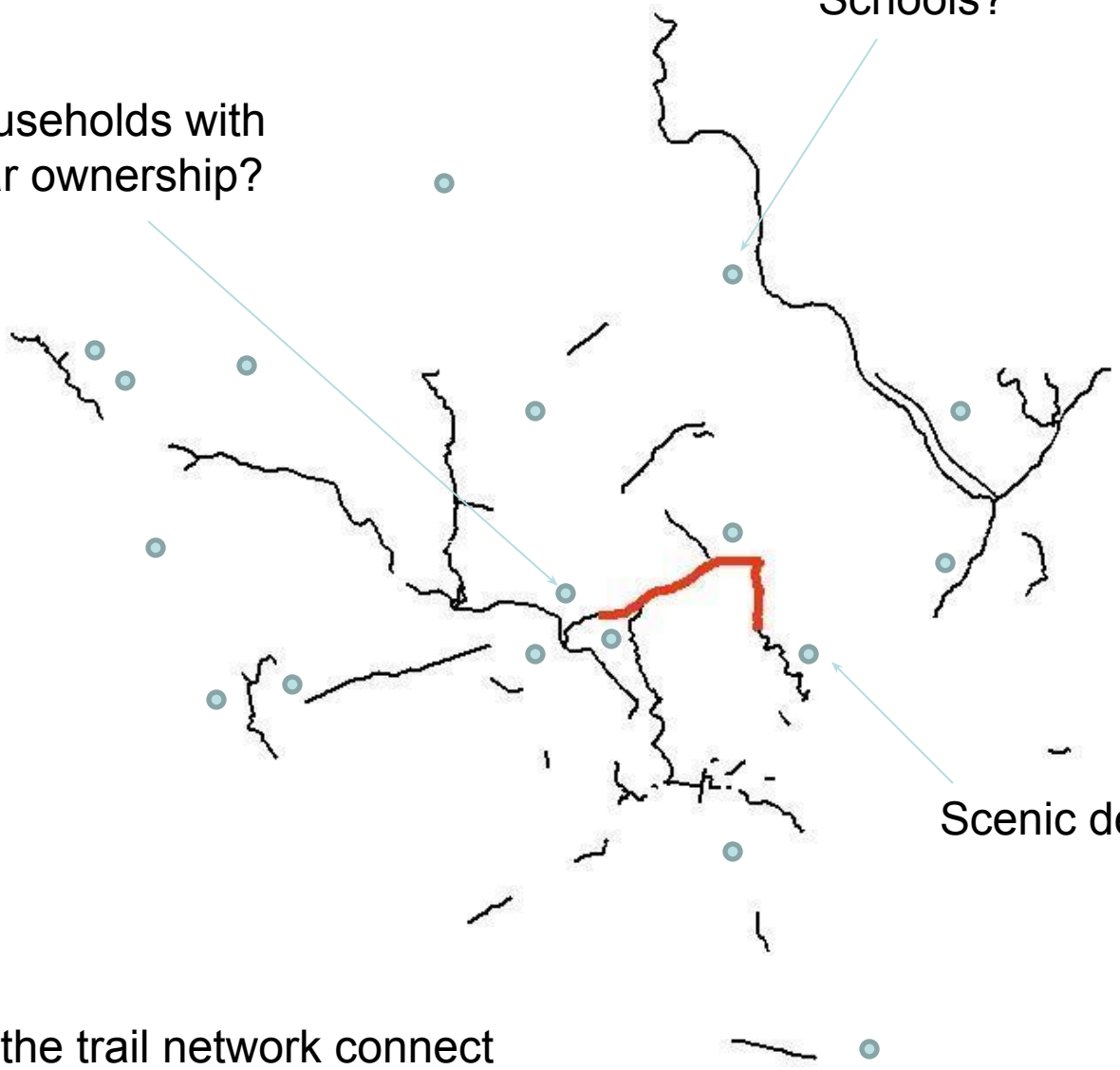


GIS allows us to calculate thousands of distances for hundreds of pairs

How well does the trail network connect these origins and destinations?

Schools?

Clusters of households with low rates of car ownership?



Scenic destinations?

How well does the trail network connect particular origins and destinations?

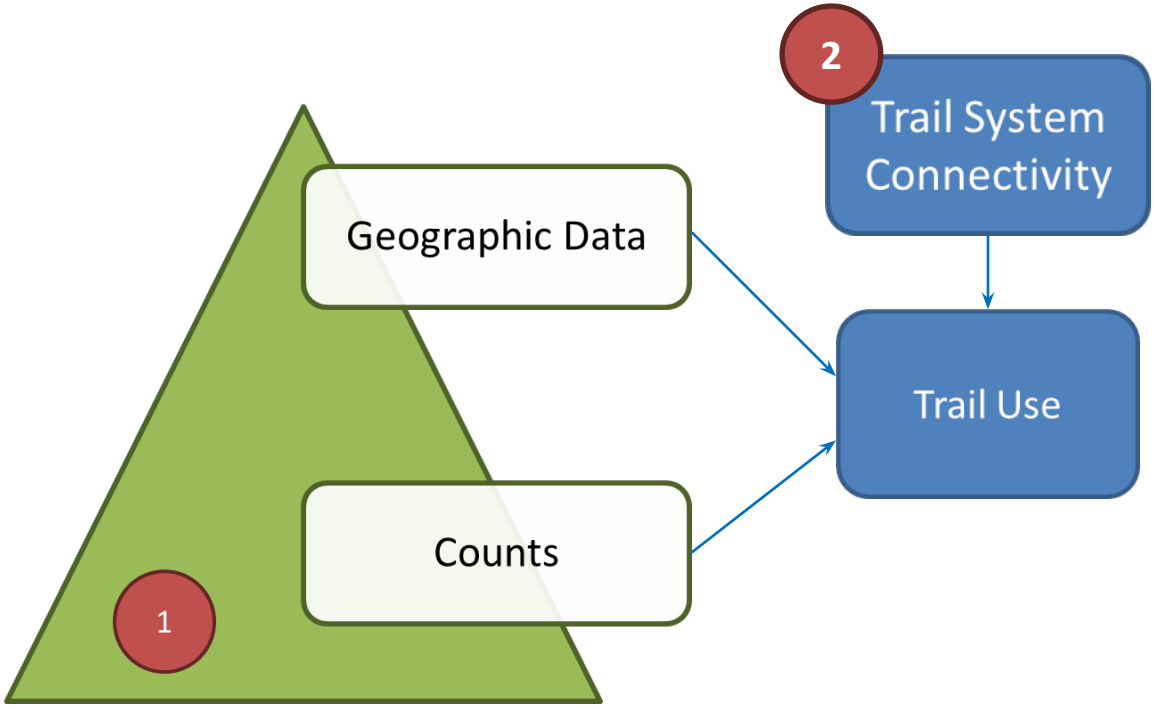
Schools?

Clusters of households with low rates of car ownership?

Scenic destinations?

How well does the trail network connect particular origins and destinations?

Year One Deliverables: Forecasting



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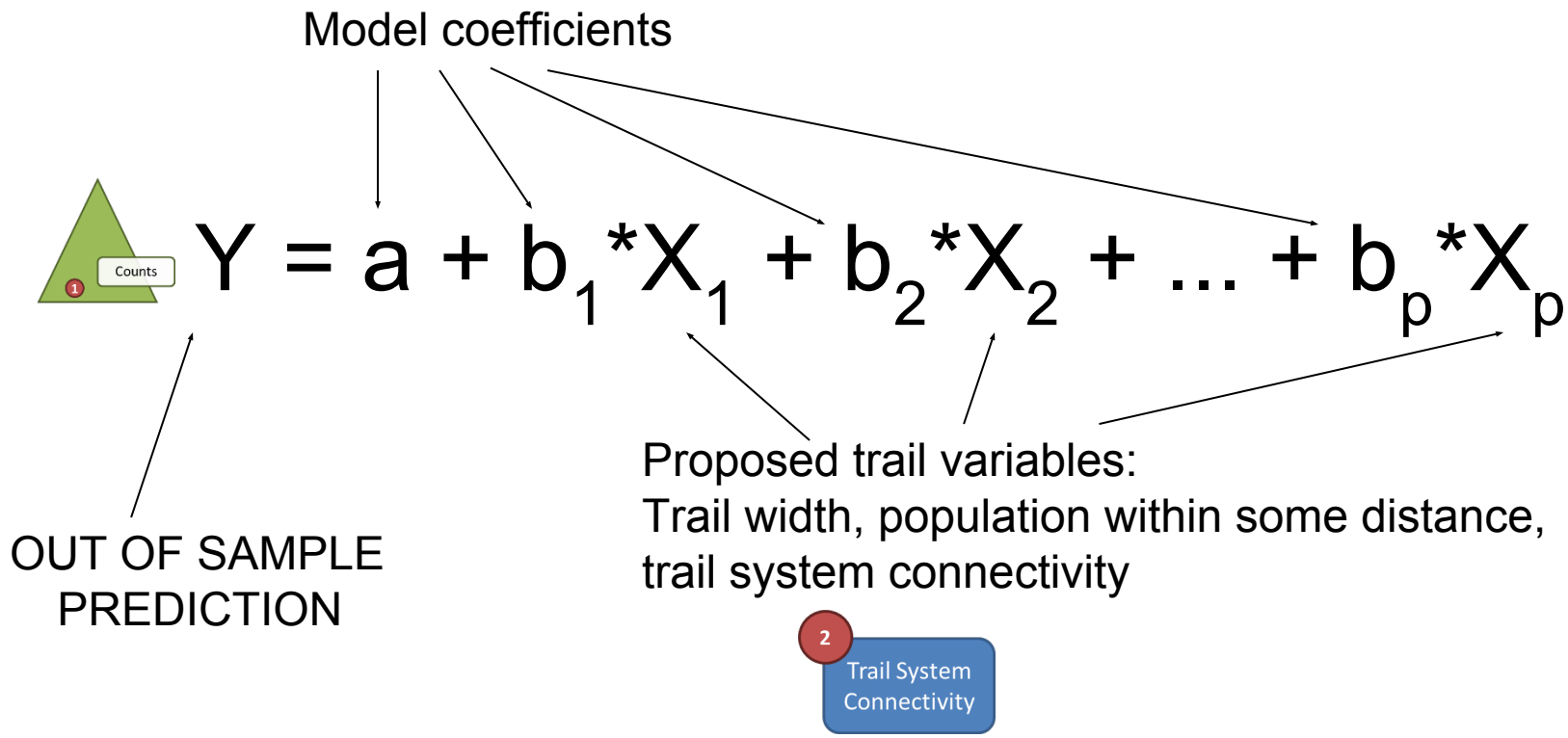
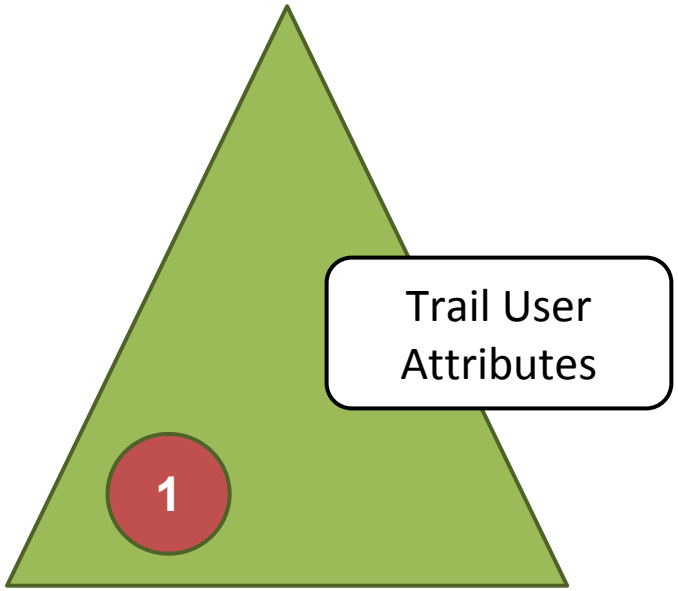


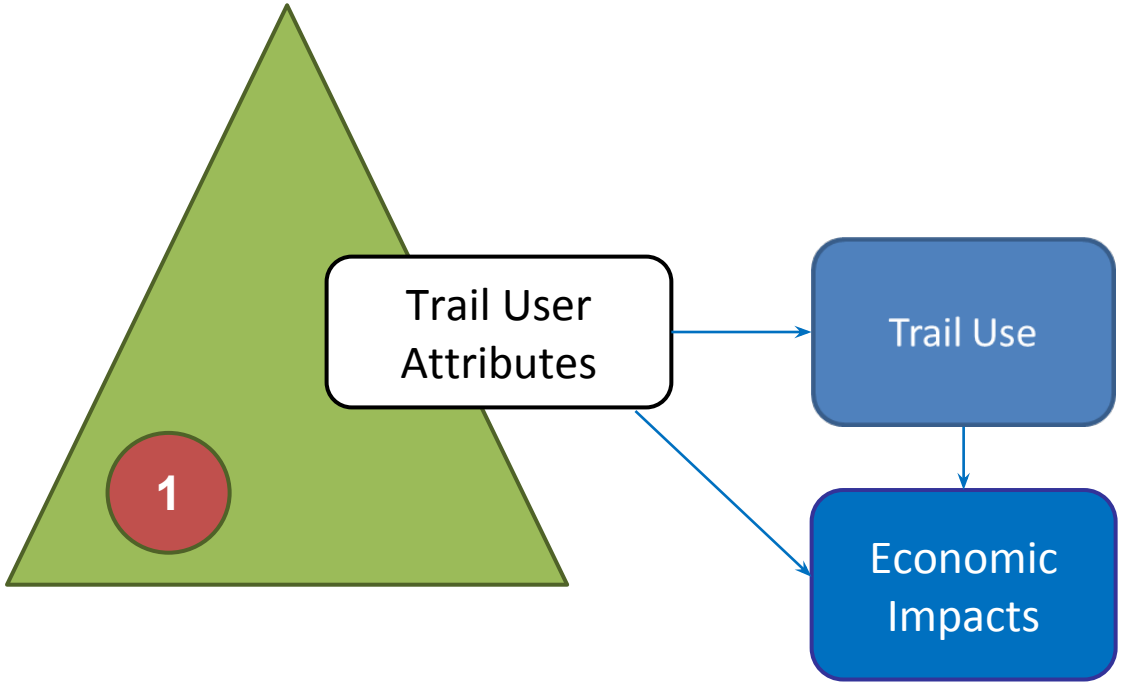
Year Two Data Collection: Survey



Trail User Research Questions

- Why do people use trails?
- What percentage of trail use replaces trips that would have taken place by other modes?
- How long is the average trail trip?
- Are the different “functional classifications” of trails that we need to know about to answer these questions?

Year Two Deliverables: EIA



Our Co-Investigators

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Driven to Discover℠

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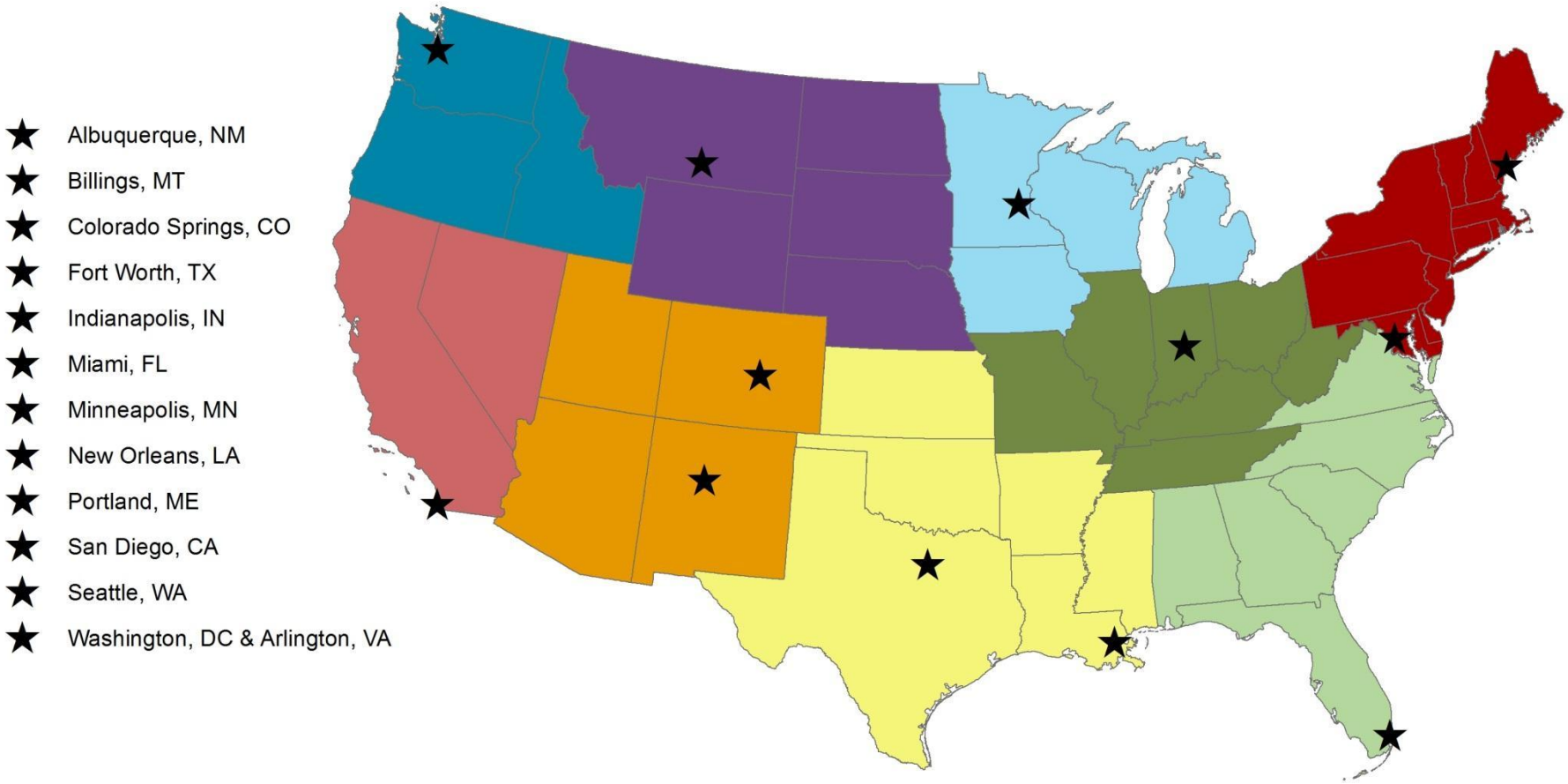
Dr. Mike Lowry

University of Idaho


Albuquerque, NM
Billings, MT
Colorado Springs, CO
Fort Worth, TX
Indianapolis, IN
Miami, FL
Minneapolis, MN
New Orleans, LA
Portland, ME
San Diego, CA
Seattle, WA
Washington, DC & Arlington, VA

TMAP
Monitoring and Modeling Urban Trail Traffic

9 March 2014

HUMPHREY SCHOOL
OF PUBLIC AFFAIRS

UNIVERSITY OF MINNESOTA
Driven to Discover℠

Our Workshop Today

- Thinking about trail traffic … an exercise
- *FHWA Traffic Monitoring Guide* (framework)
  - Some decisions to make
- Trail Traffic in Minnesota
  - Some monitoring results
  - Some factoring results
  - Some modeling results
- TMAP – trail monitoring and modeling

Motivation

- *How many people are on our trails?*
  - » Ray Irvin, Indy Parks Greenways, 1996
- No examples of continuous monitoring of bicyclists and pedestrians
  - » Hunter and Huang, 1995
- Quality of data about "*number of bicyclists and pedestrian by facility … is* "*poor*" and the "*priority for better data is* "*high*"
  - » Bureau of Transportation Statistics, 2000

Key Questions

- Advocacy question
  - How do we equip trail advocates and allies with evidence and tools?
- Policy and management question
  - How do we optimize investment in infrastructure for non-motorized transportation – biking and walking?
- Research question
  - How do we monitor, measure, and model urban trail traffic?

Federal Highway Administration Traffic Monitoring Guide: April 2013

- First edition of the TMG with information on monitoring non-motorized traffic (Ch 4)
- “Basic guidance … to improve the state-of-the-practice”
- “Systematic monitoring…still an emerging area”
- “Limited information … about best and most cost-effective way to automatically collect non-motorized traffic data”

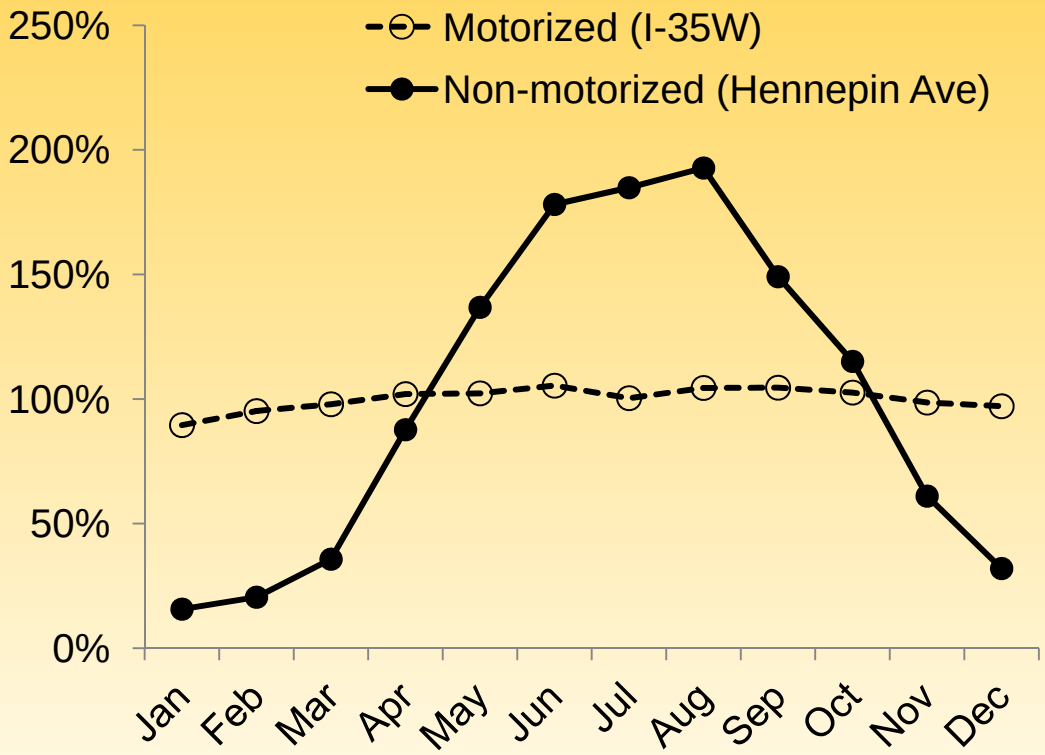
FHWA Traffic Monitoring Guide

Permanent Continuous Monitoring	Short Duration Monitoring
1. Review existing continuous count program	1. Select count locations
2. Develop inventory of available continuous count locations and equipment	2. Select type of count (segment vs intersection)
3. Determine the traffic patterns to be monitored	3. Determine duration of counts
4. Establish seasonal pattern groups	4. Determine method of counting (automated vs. manual)
5. Determine number of continuous count locations	5. Determine number of count s
6. Select specific count locations	6. Evaluate counts (QA/QC)
7. Compute adjustment factors	7. Apply factors (occlusion, time of day, day of week, monthly, seasonal)

TMG: Important Differences between Motorized and Non-Motorized Monitoring

- Scale of non-motorized data collection more limited
- More experience with manual (very) short-duration counts (e.g., 2 hours) than automated counts
- Technologies for automated non-motorized counting still evolving; error rates unknown
- Standard procedures for analyzing data not developed

Motorized and Non-motorized Monitoring



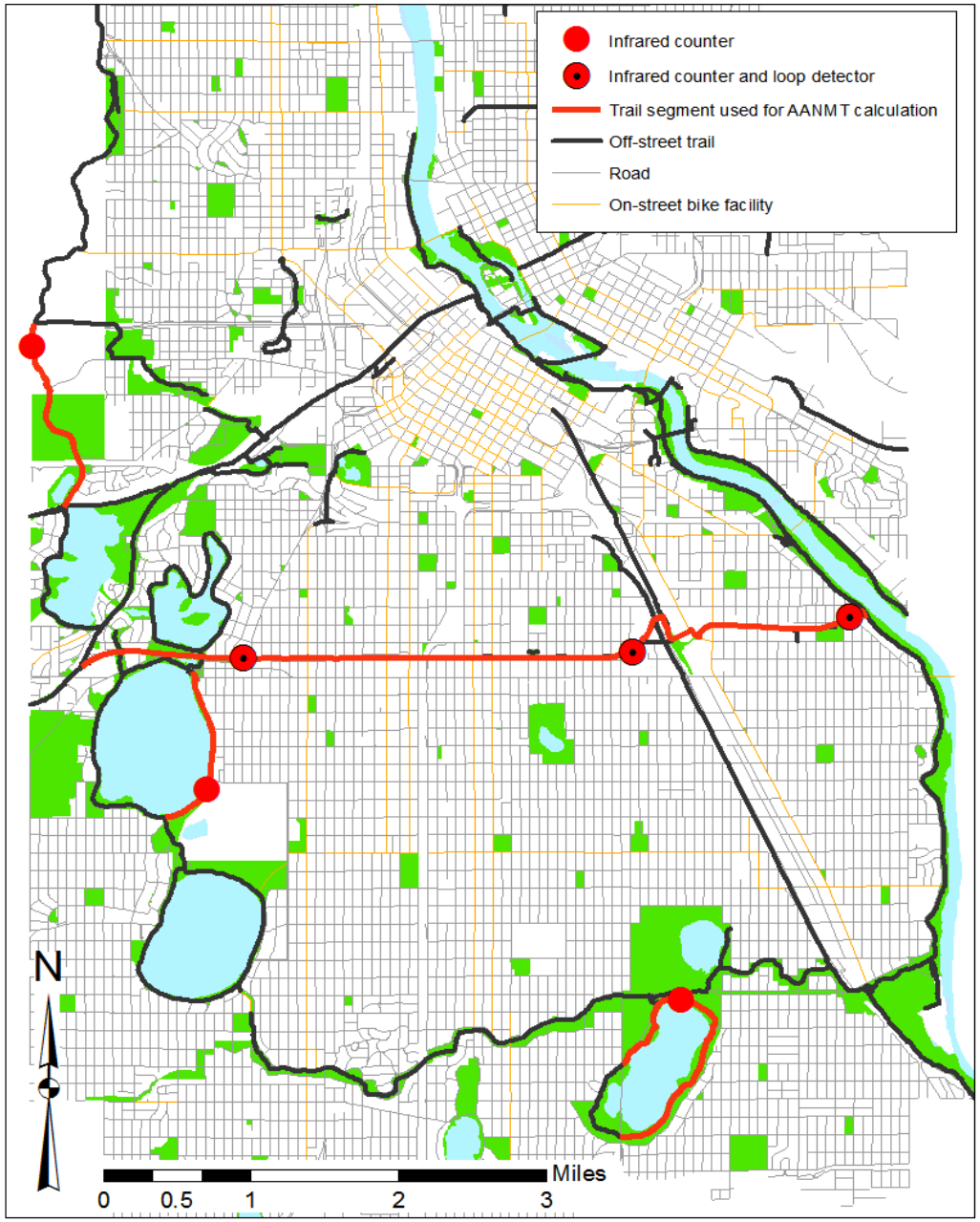
What are implications of differences in traffic patterns for monitoring and modeling?

Practical Decisions in Monitoring and Modeling

1. Purpose, goal for monitoring
2. Monitoring locations (system/network, trails, segments, reference and short-duration sites)
3. Monitoring technologies
4. Quality assurance/quality control procedures
5. Analytics methods (factor groups, correction factors, factoring method)
6. Modeling procedures (land use regressions)
7. Resources to sustain and improve

Trail Monitoring in Minneapolis

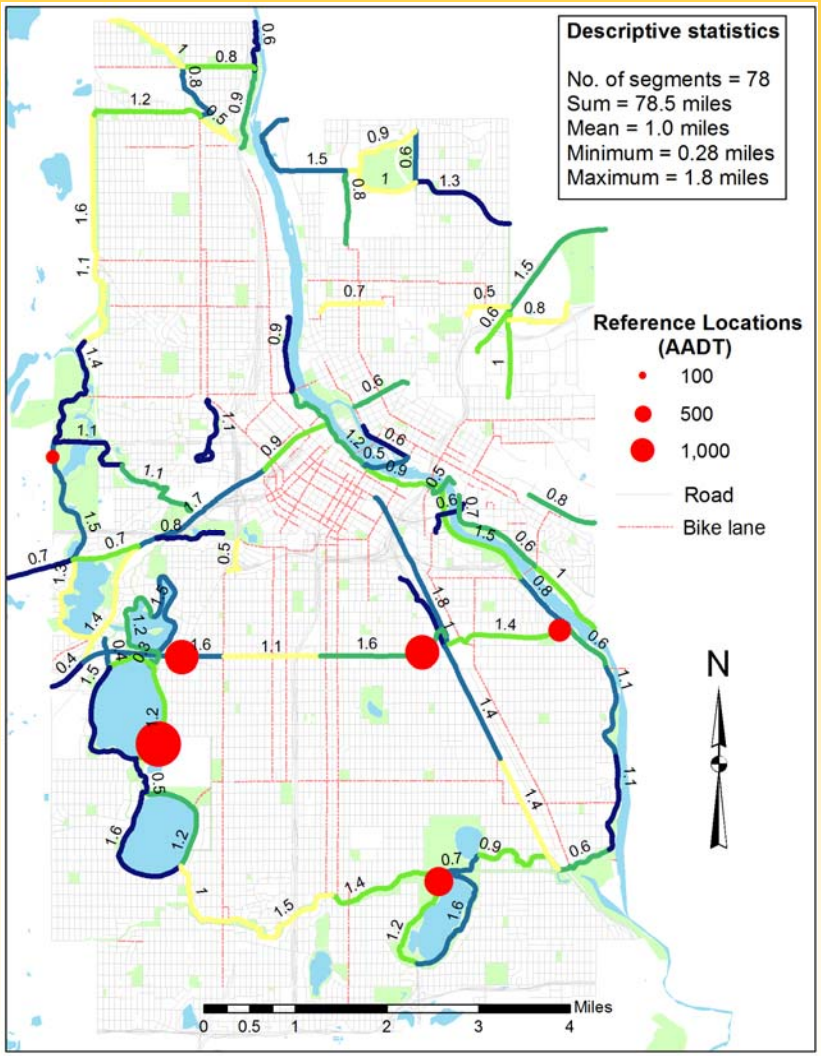
1. Purpose	• Estimates of average annual daily trail traffic, miles traveled (mixed mode = bikes & peds)
2. Locations	• 6 reference sites, 76 short-duration locations
3. Technologies	• Trail Master Active Infrared Counters (& inductive loops)
4. QA/QC	• On-site calibration, outliers, correction for occlusion, systematic error
5. Analytics	• Two-step factoring, day-of-year factors
6. Modeling	• Negative binomial land use regression, weather controls
7. Sustainability	• Collaboration, scrambling



Automated Traffic Monitoring on Multiuse Trails in Minneapolis

Typical Monitoring Site: Midtown Greenway

Trail Segments for Short-Duration Counts



No. of segments = 80
Sum = 78.3 miles
Mean = 0.98 miles
Min = 0.17 miles
Max = 1.8 miles

Infrared Technology

- Trail Master (TMI) active infrared counters
  - "Counts" when user breaks beam
  - Does not distinguish bikes and peds
  - Systematic undercount (occlusion – users passing simultaneously)

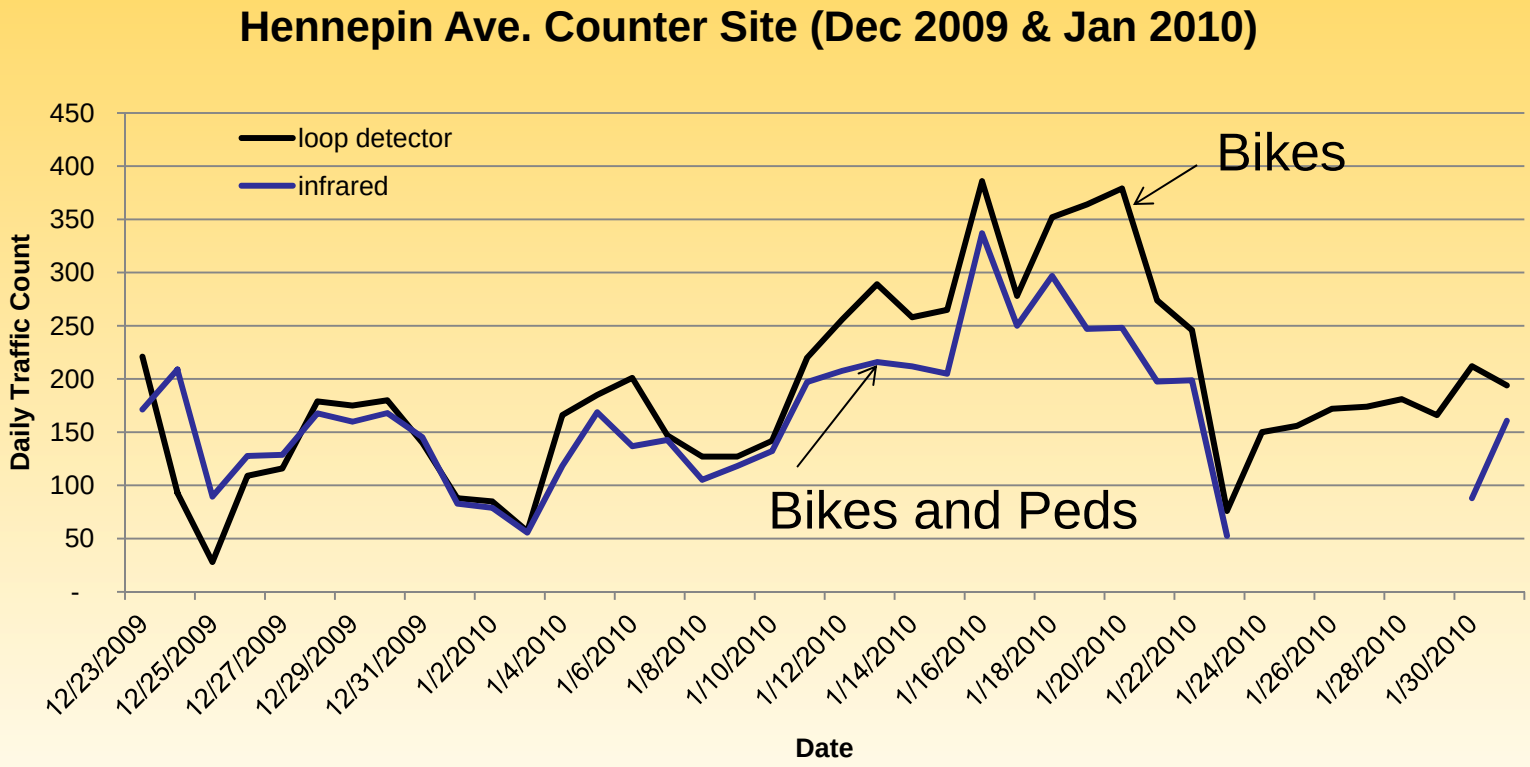
- Labor intensive
- Old technology

Inductive Loop Technology

- Inductive loop counters (3 locations)
  - Counts when bicycles ride over loop in pavement
  - Only counts bicycles
  - Installed by Dept. of Public Works in 2007
  - Counts not validated by city

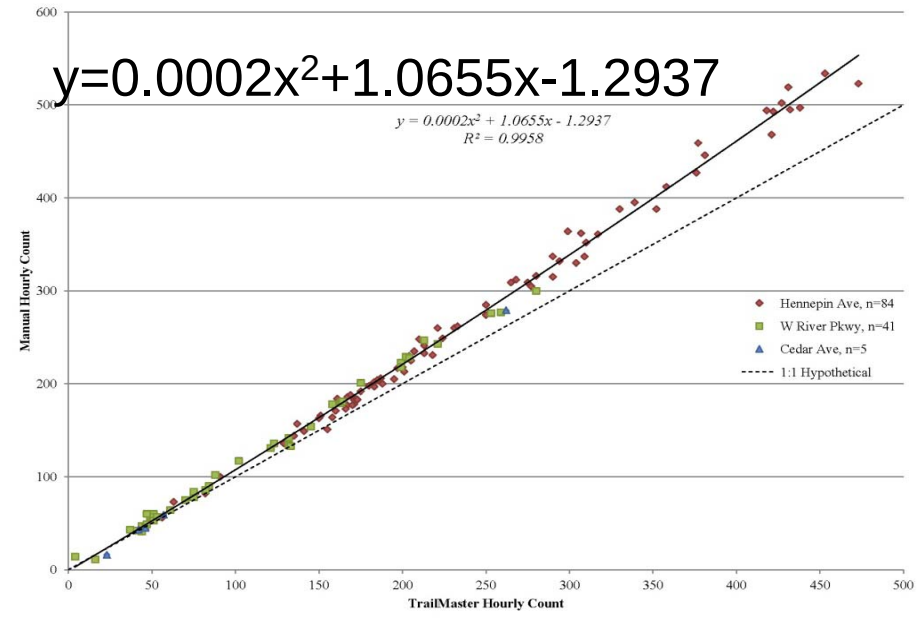
QA/QC: A Calibration Problem

Counts (bikes) > Infrared Counts (bikes & peds)



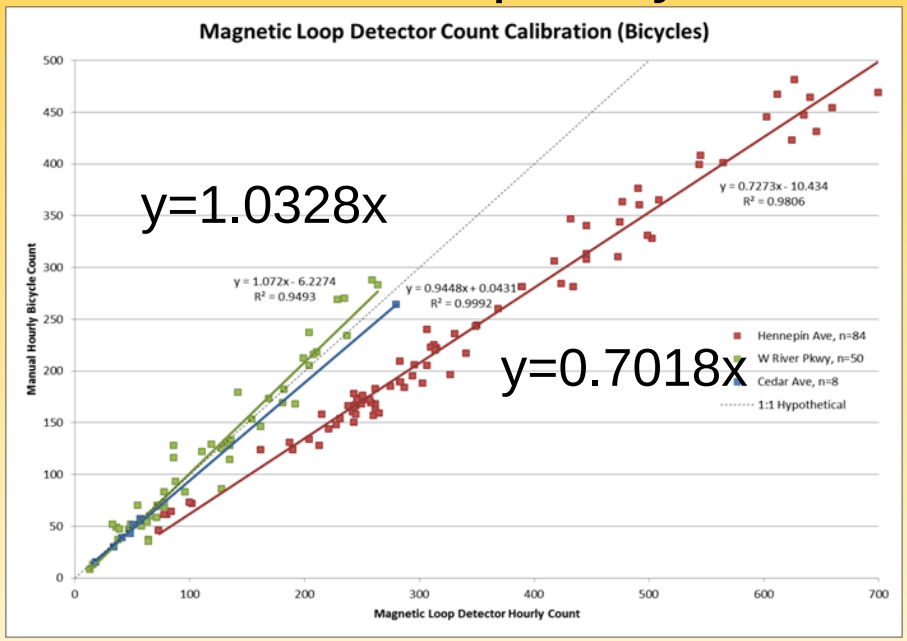
Quality Assurance / Qualtiy Control

Active Infrared: Mixed Mode



- Systematic undercounts due to occlusion
- Hourly adjustment equations same across locations

Inductive Loop: Bicycles



- Over and undercount due to installation, maintenance
- Hourly adjustment equations vary by location

Correction Equations for Automated Counters by Mode

Monitoring Location(s)	Type of Monitor	Mode	Hours of Validation	Hourly Traffic Adjustment Equations*
All six locations	Active infrared	Mixed	130	$y=0.0002x^2+1.0655x-1.2937$
Lakes Calhoun and Nokomis	Active infrared	Peds	20	$y=1.2920x$
Lakes Calhoun and Nokomis	Active infrared	Bikes	19	$y=1.078x$
Midtown Greenway: Hennepin	Inductive Loop	Bikes	86	$y=0.7018x$
Midtown Greenway: Cedar	Inductive Loop	Bikes	8	$y=0.9451x$
Midtown Greenway: W. River Parkway	Inductive Loop	Bikes	51	$y=1.0328x$

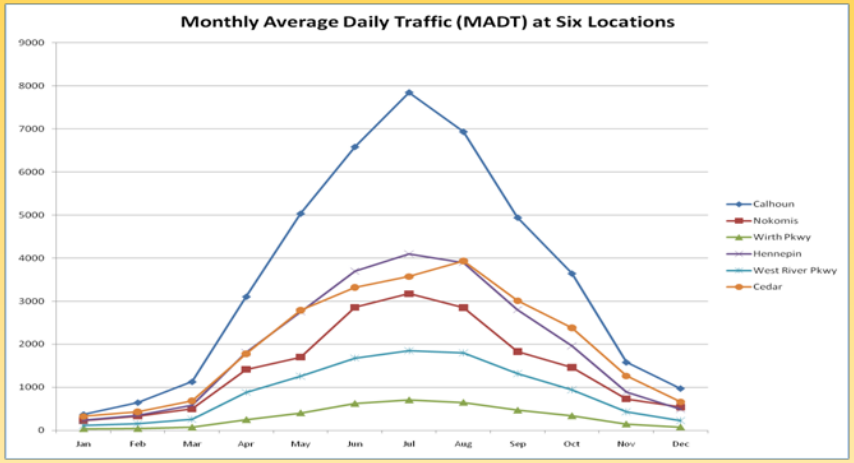
y = estimated hourly traffic; x = hourly count from monitor

Average Annual Daily Bicycle & Pedestrian Traffic

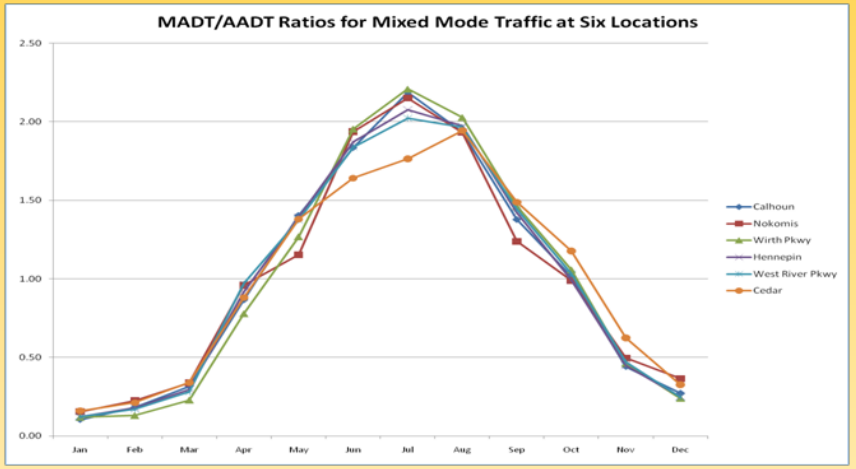
Location / Mode	Estimated Total Annual Traffic	Estimated AADT	Percent of Traffic at Site
(1) Hennepin Ave. & Midtown Greenway (MGW)			
a. Bicycle	629,262	1,724	87%
b. Pedestrian	91,451	251	13%
c. Total – mixed-mode	720,714	1,975	100%
(2) West River Pkwy & MGW			
a. Bicycle	320,198	877	96%
b. Pedestrian	13,196	36	4%
c. Total – mixed-mode	333,395	913	100%
(3) Cedar Ave. & MGW			
a. Total – mixed-mode	738,336	2,023	100%
(4) Lake Calhoun Parkway*			
a. Bicycle (outer)	494,209	1,354	38%
b. Pedestrian (inner)	814,434	2,231	62%
c. Total – mixed-mode	1,308,643	3,613	100%
(5) Lake Nokomis Parkway*			
a. Bicycle (outer)	193,843	531	36%
b. Pedestrian (inner)	344,604	944	64%
c. Total – mixed-mode	538,448	1,475	100%
(6) Wirth Parkway – mixed-mode	116,765	320	100%
Six Location Mixed-Mode Total	3,756,301	10,291	100%

Monthly Mixed Mode Traffic Patterns

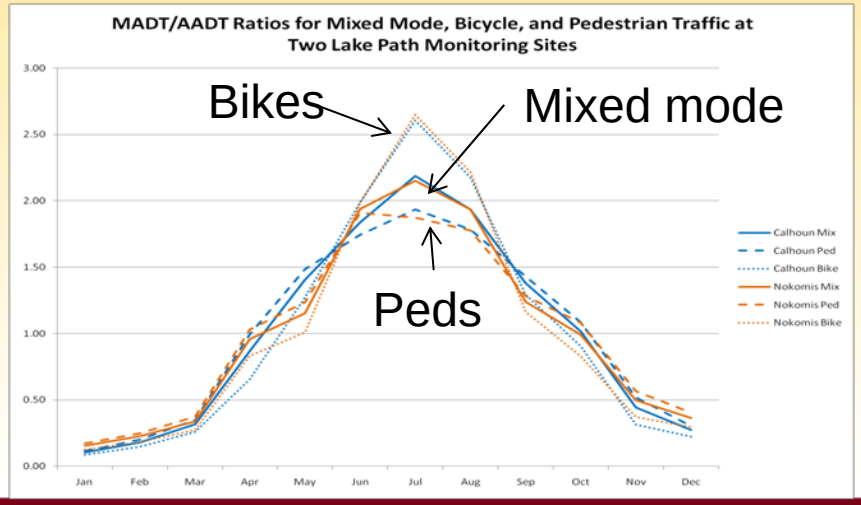
Monthly mean daily traffic



Monthly/annual mean daily traffic



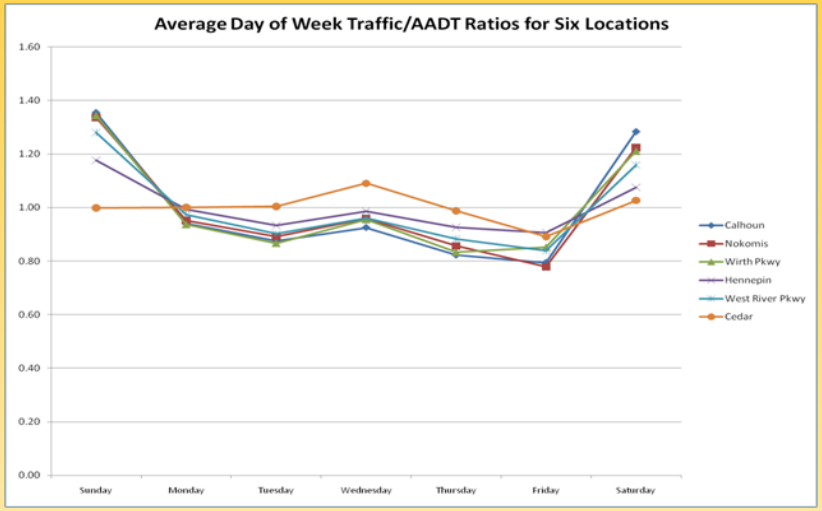
Monthly/annual mean daily traffic by mode



- Mixed mode traffic varied by an order of magnitude across sites
- Monthly to annual mean daily traffic ratios generally were consistent across sites.
- Bicycle traffic is characterized by greater seasonality than pedestrian traffic.

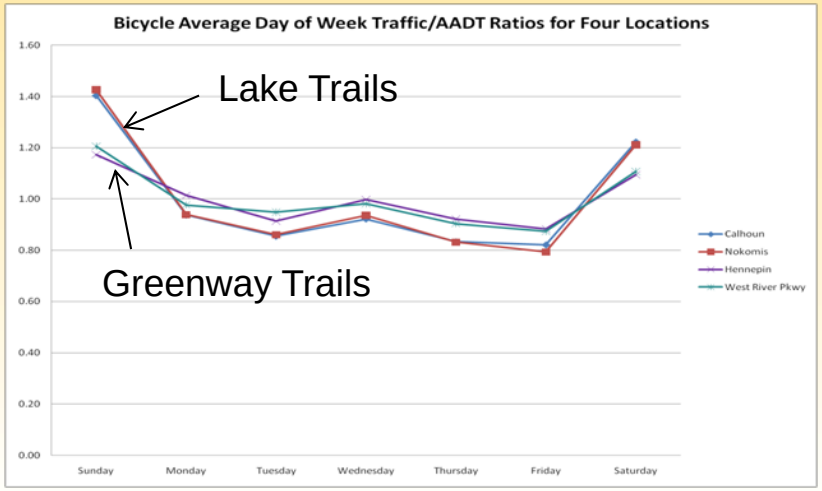
Mean Day of Week Traffic / Annual Mean Daily Traffic

Mixed mode: six monitoring sites

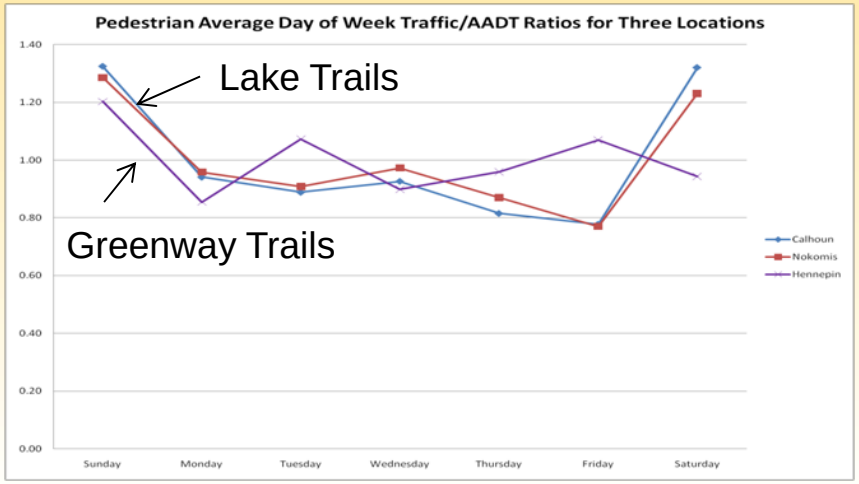


- Mixed-mode day of week scaling factors generally are consistent across locations with higher traffic on weekend days.
- Bicycle day of week factors vary by location, with greater weekend traffic ratios at recreational sites around lakes.
- Pedestrian do not appear to vary as much as bicycle factors but reflect greater day-of-week variability.

Bikes: recreational and “utilitarian” trail sites

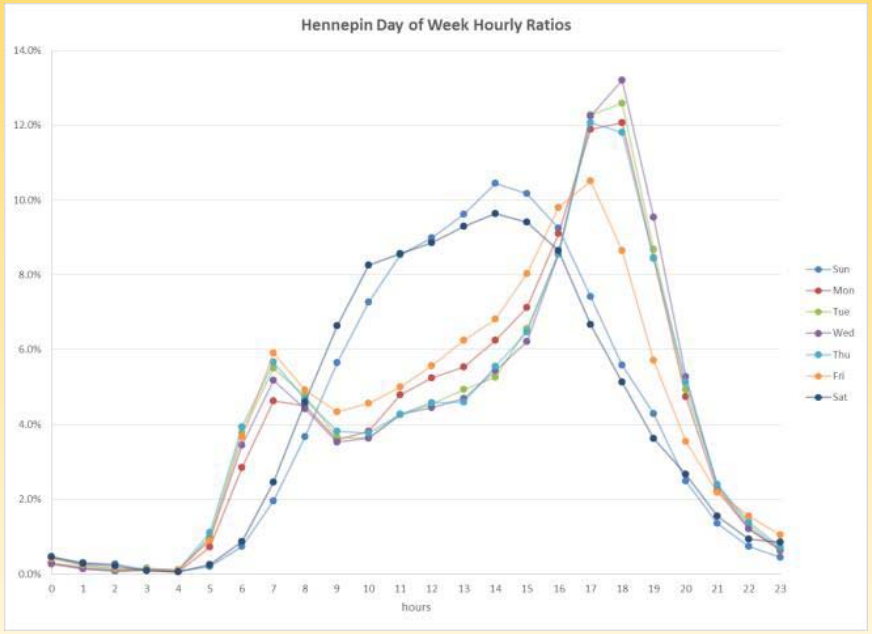


Peds: recreational and “utilitarian” trail sites

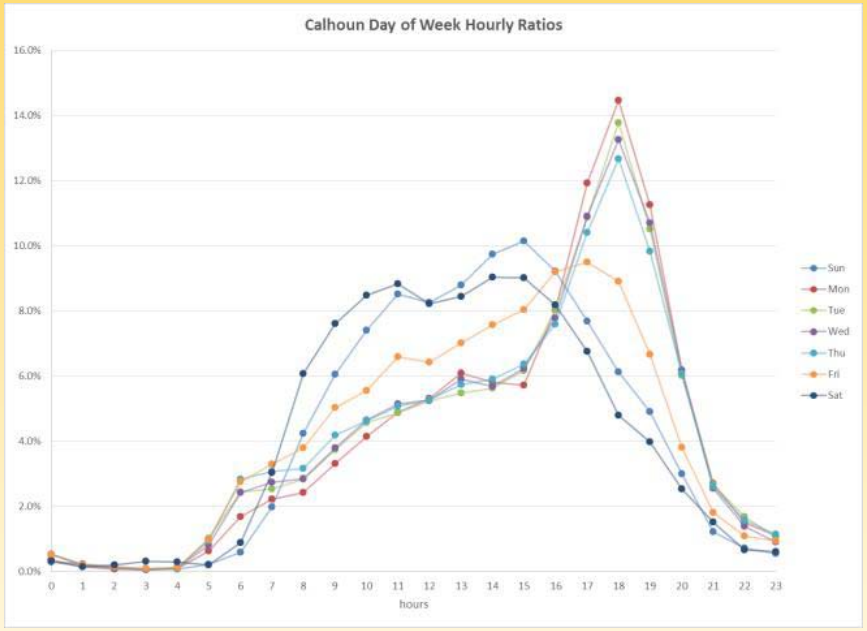


Weekday and Weekend Hourly Traffic (%)

Midtown Greenway Hennepin

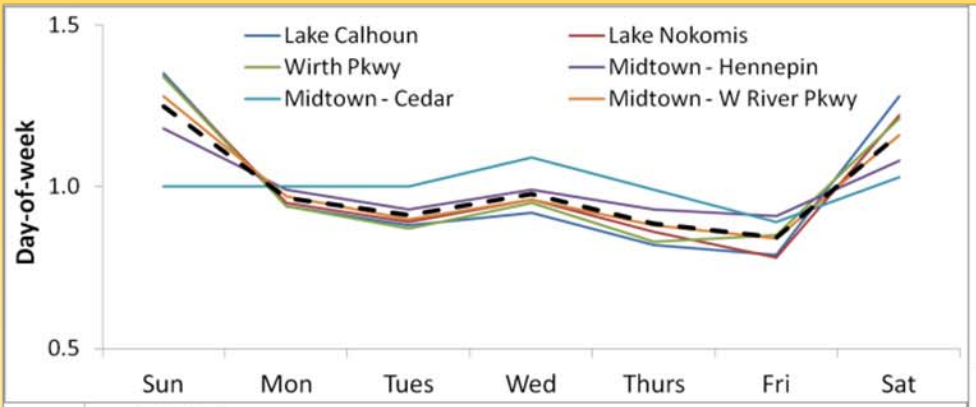


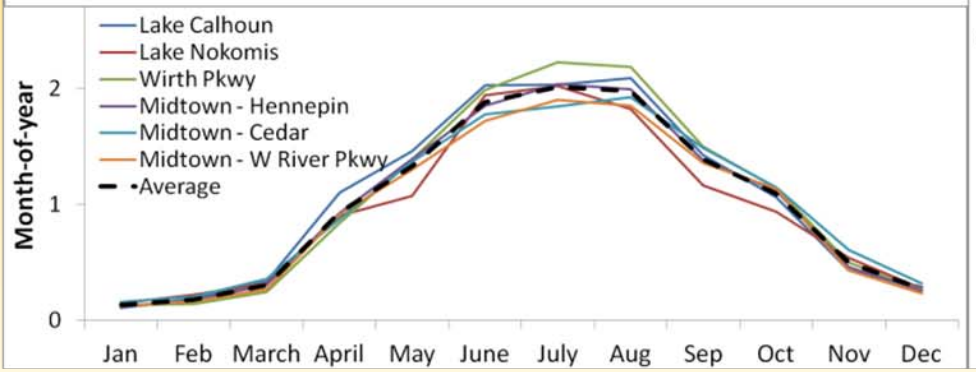
Lake Calhoun Trail

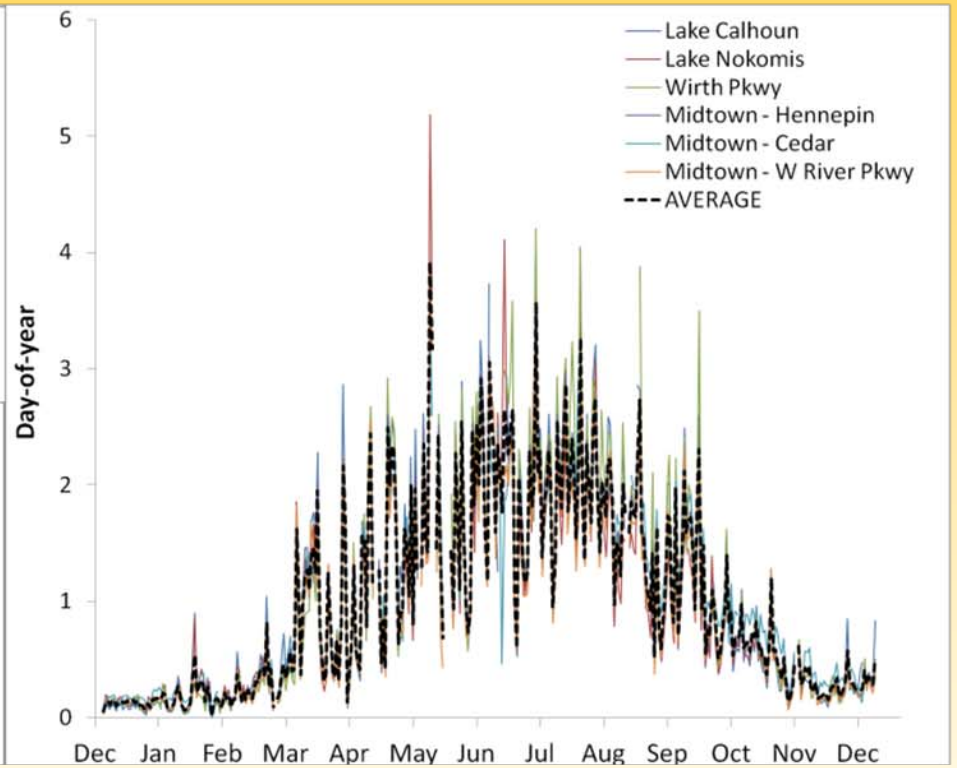


Note: Friday similarities to weekend at lake trail

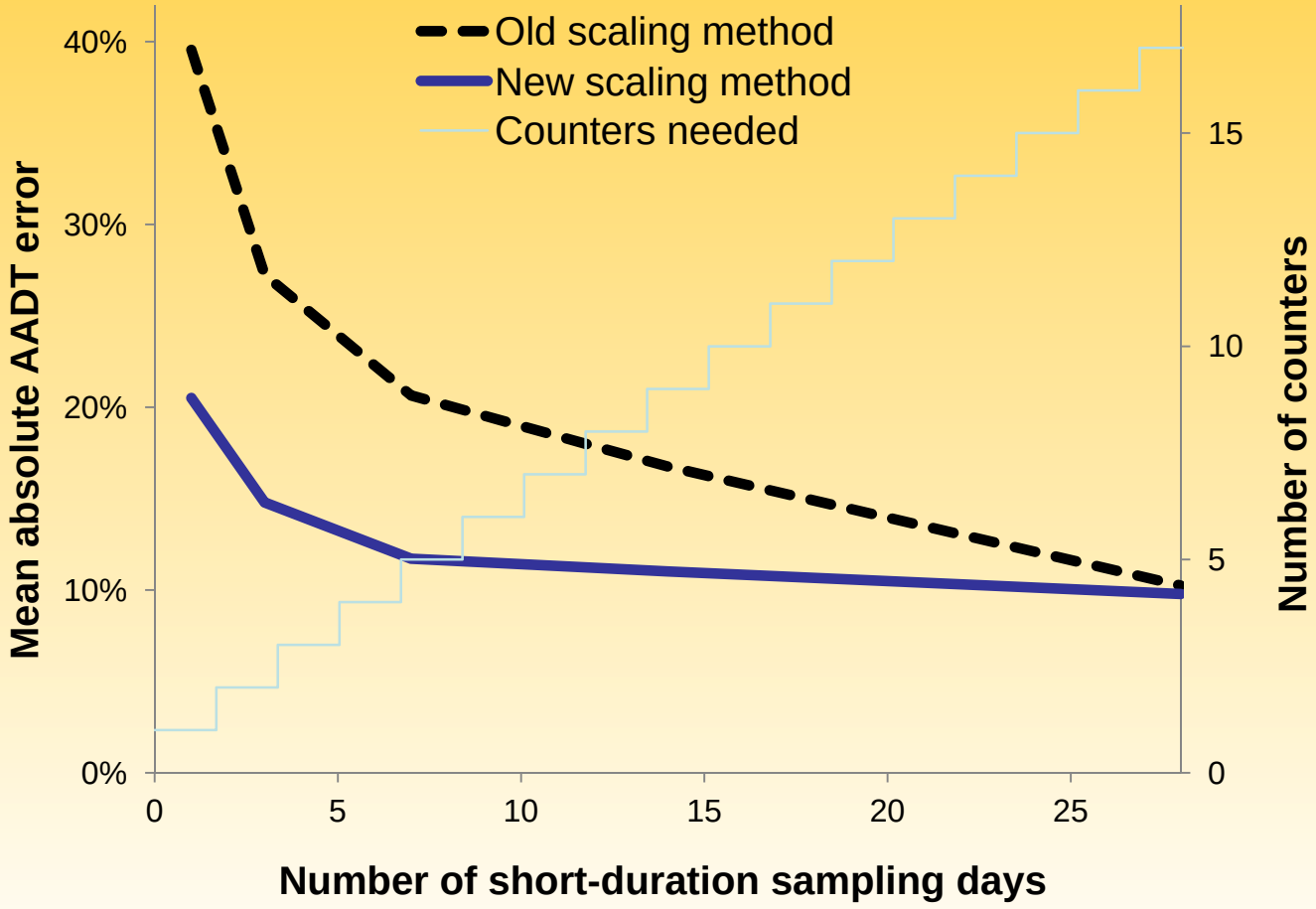
Adjustment Factors for Short-duration Counts:
Day-of-Week, Month-of-Year vs. Day-of-Year



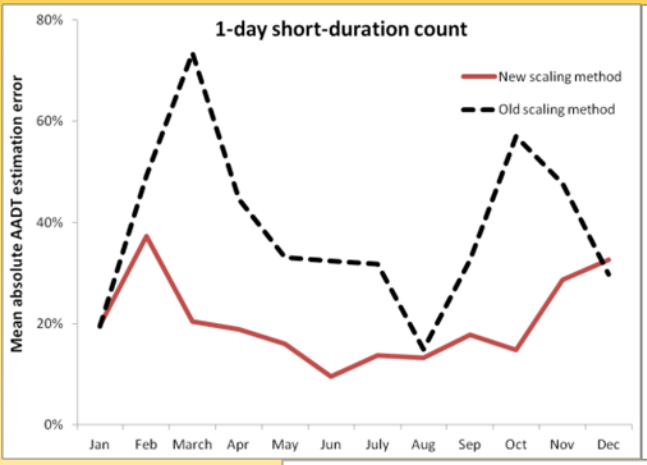


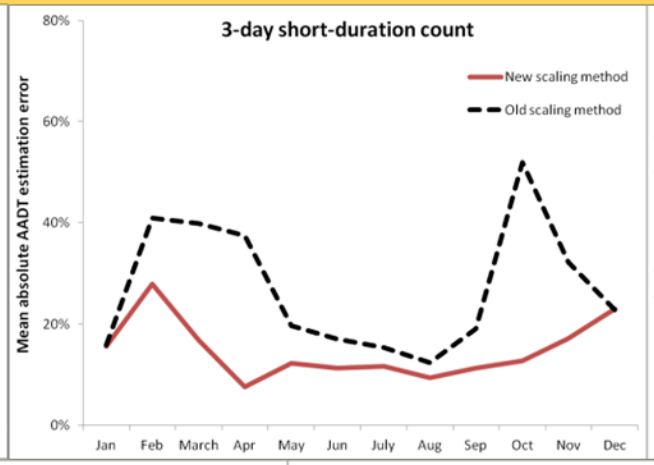


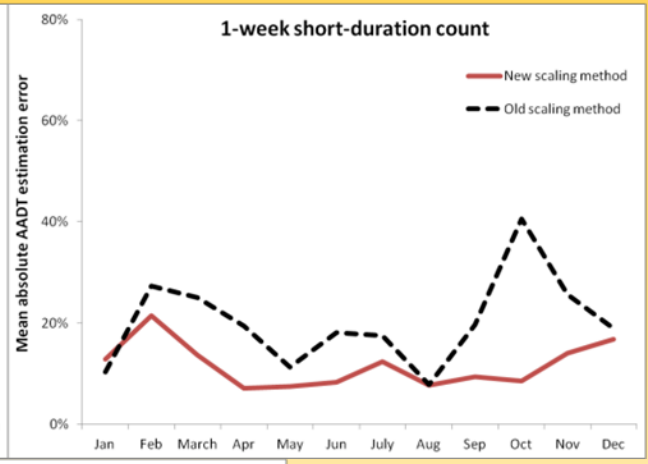
Day-of-Year Factors Reduce Extrapolation Error

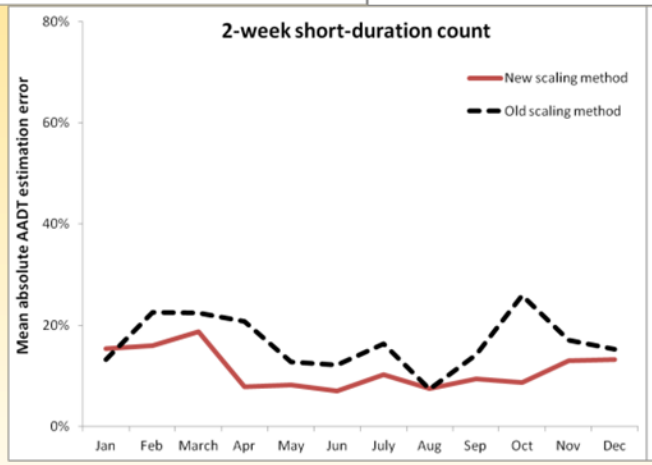


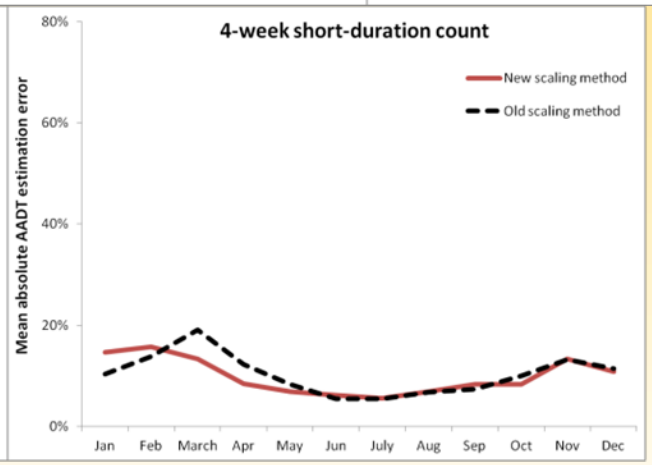
Sampling from April to October Minimizes Extrapolation Error





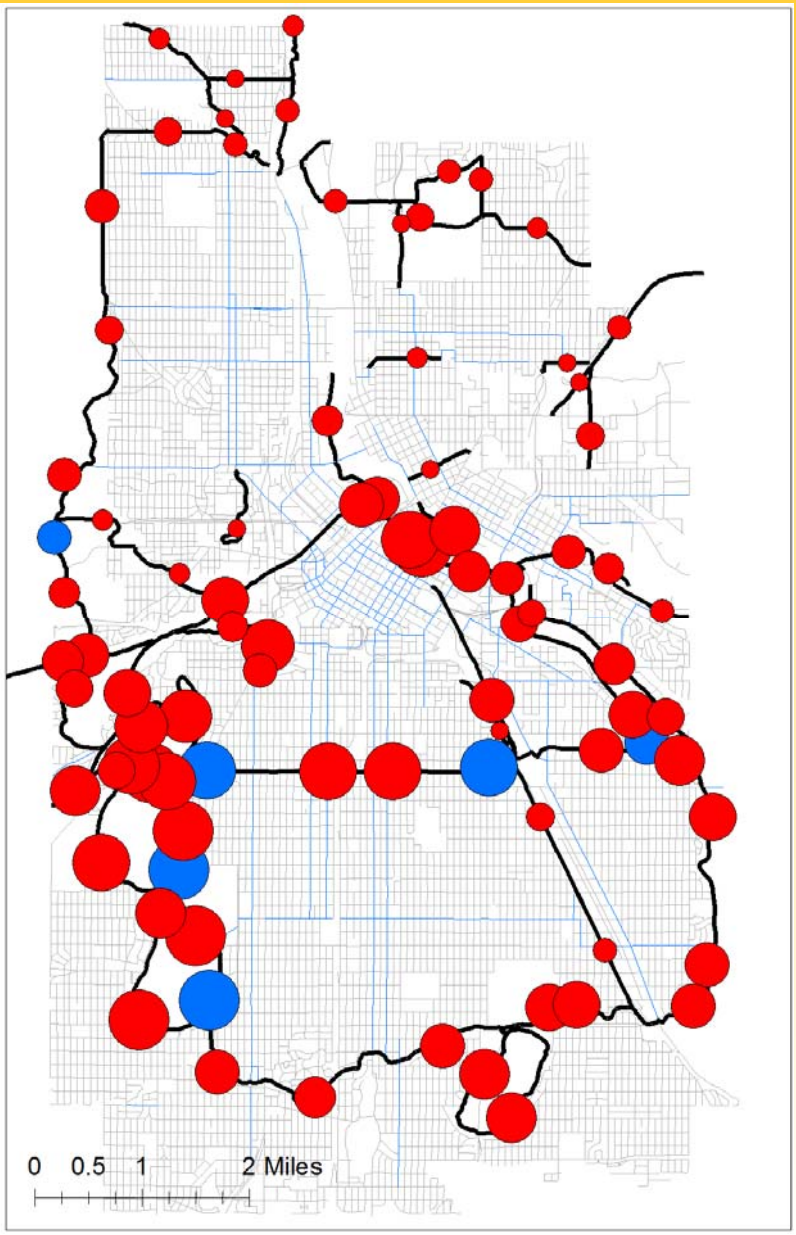






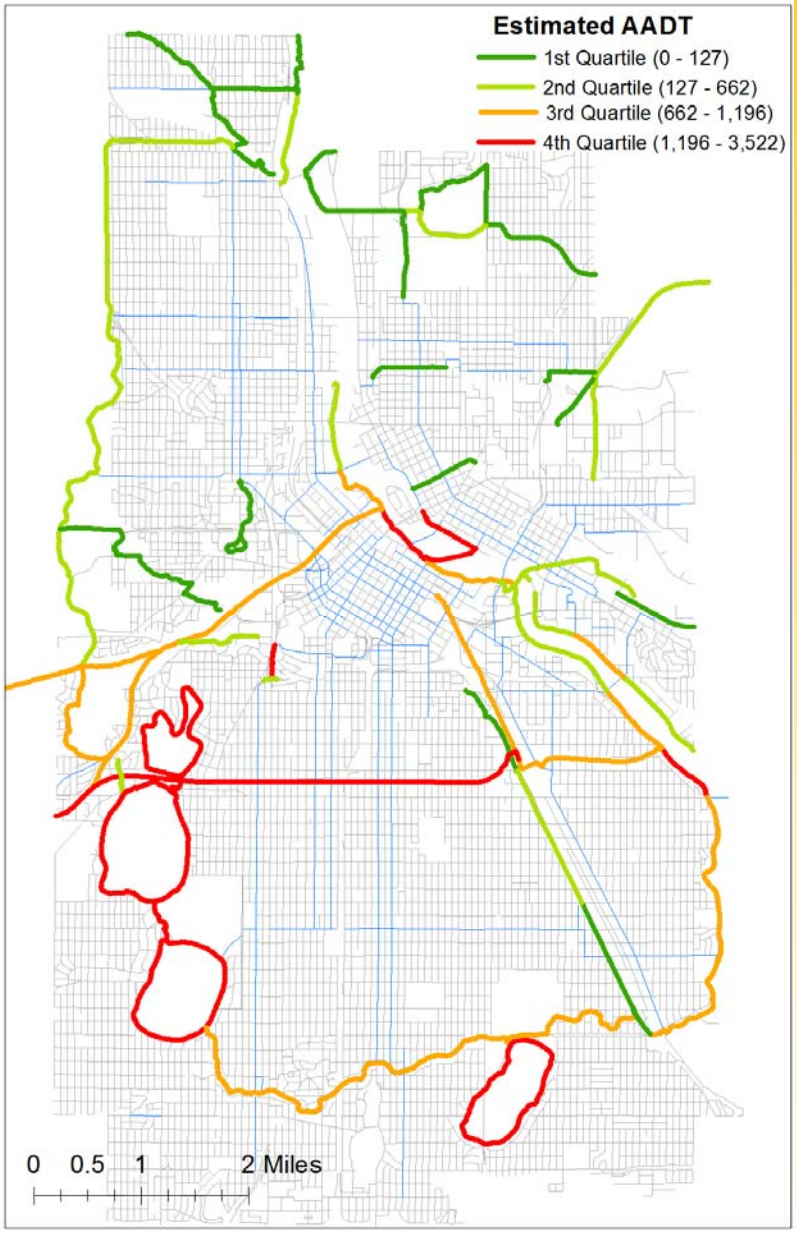
Average Annual Daily Trail Traffic

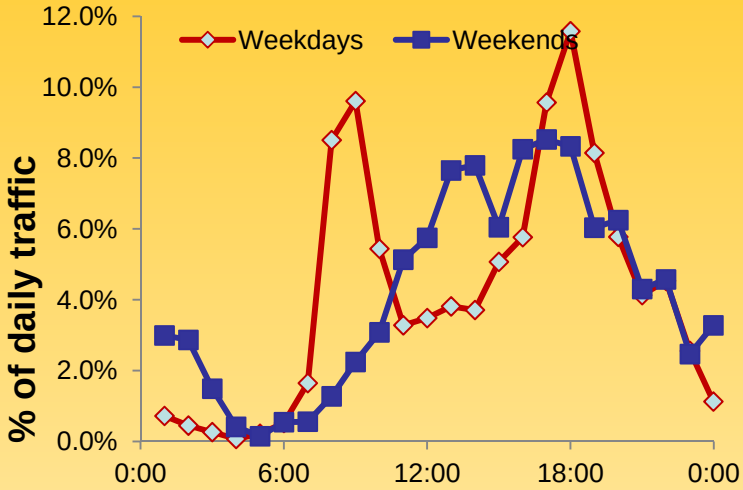
Segment	AADT
Mean	954
Median	750
Max	3,728
P90	2,321
P75	1,264
P25	142
P10	81
Min	39



AADT by Trail Segment

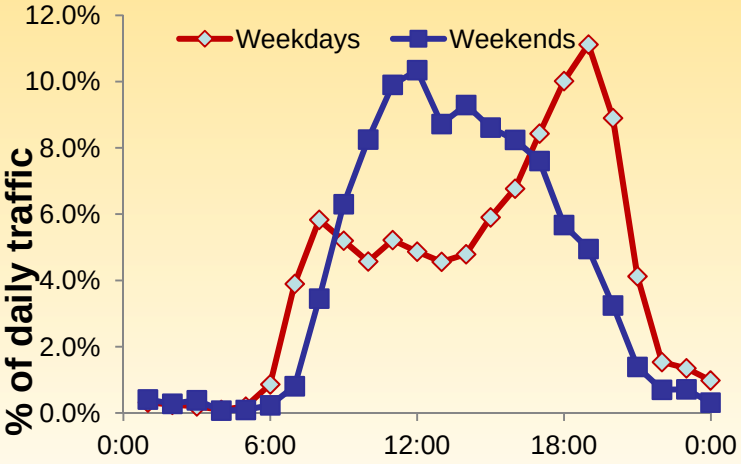
- Estimate: ~28 million user-miles traveled
- Lake, Mississippi River, Midtown Greenway Trails most heavily used
- Patterns reflect flows to central business district, university
- Trails in north Minneapolis (low income, minority populations used least)



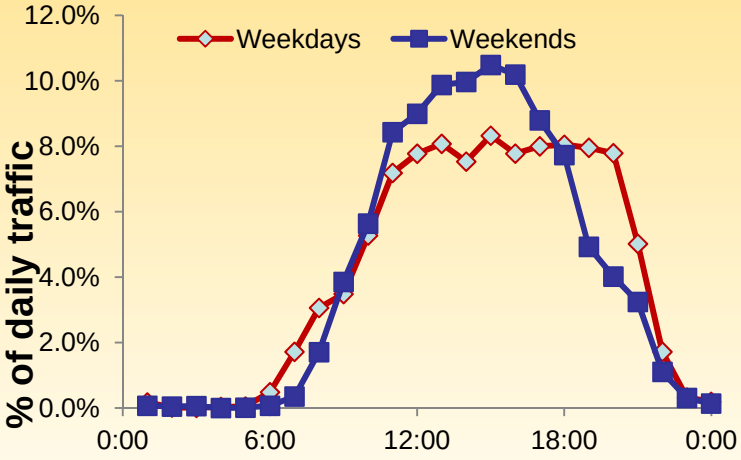


Utilitarian (weekday)

Short-duration monitoring identified three factor groups. Need new reference monitoring sites.



Mixed Recreational - Utilitarian



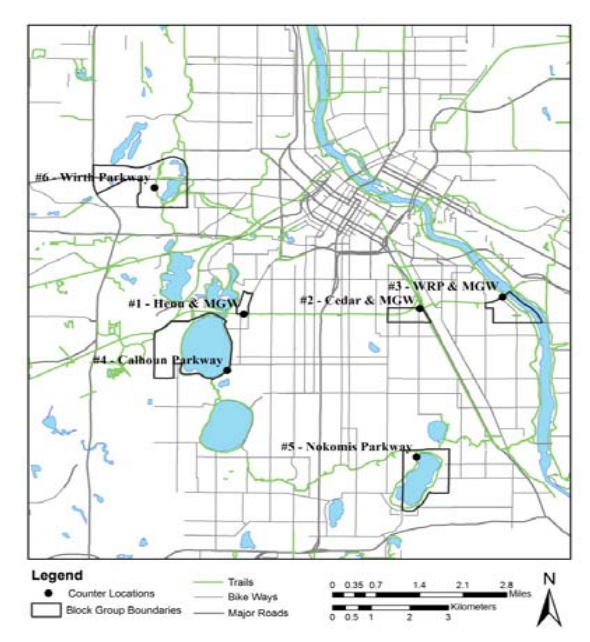
Recreational

Some Observations

- Traffic volumes on shared-use paths significant
- Systematic error in existing counts (occlusion)
- Volumes vary substantially across locations
- Mode-mix varies substantially across locations
- Traffic follows hourly, daily, monthly patterns
- Patterns vary across locations
- Adjustment factors enable extrapolation of short duration counts (day-of-year better)
- Can estimate miles traveled on trail network
- Need to reconfigure reference sites

Estimating Modeling from Counts

- Objective
  - Estimate daily mixed-mode traffic on multiuse trails
- Approach
  - Daily traffic volume =
    - Weather
    - Neighborhood socio-demographics
    - Urban form and built environment
    - Transportation infrastructure

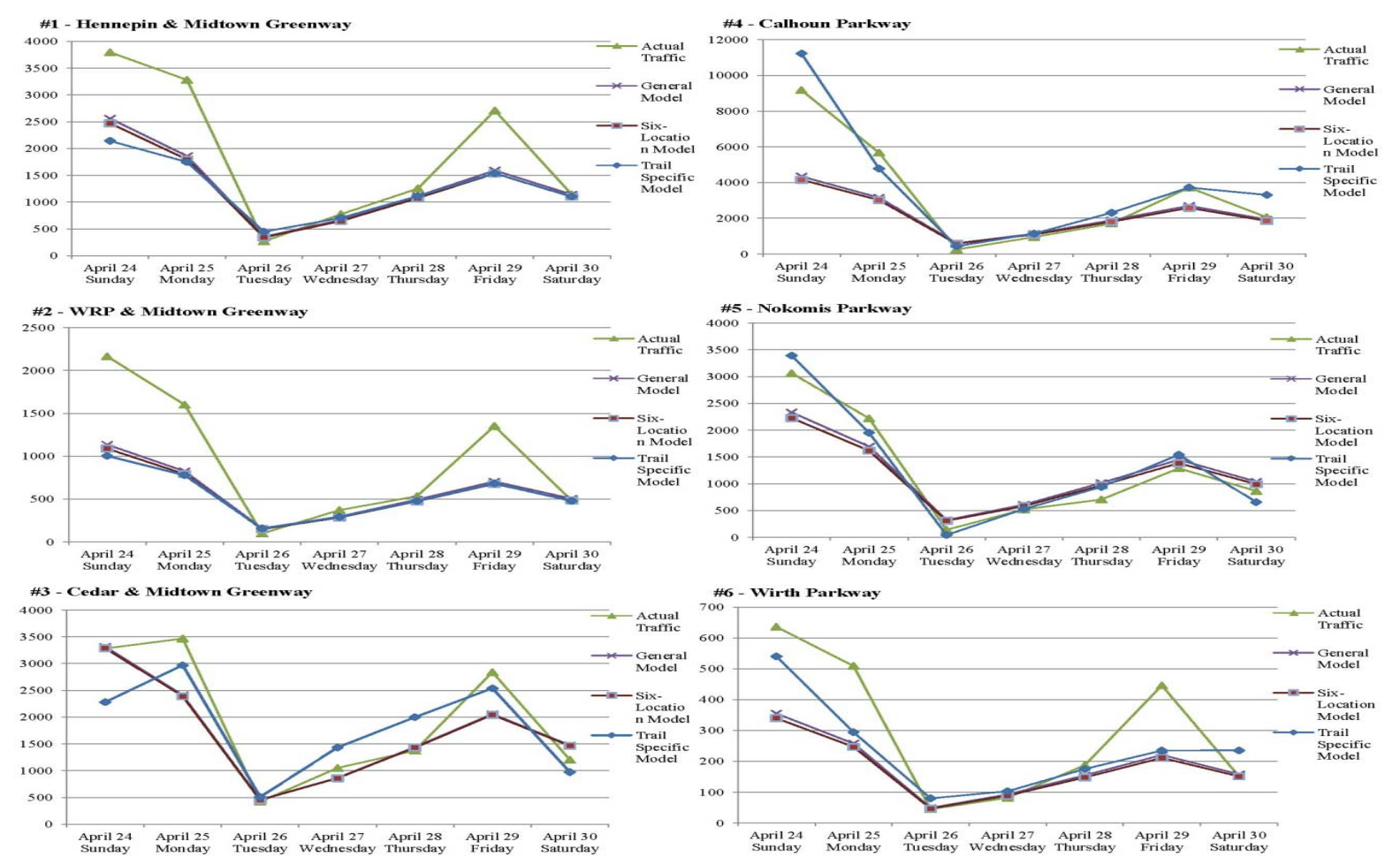


Modeling Mixed Mode Daily Trail Traffic

Variables		Expected Sign
Neighborhood Socio-demographic Characteristics		
	African American residents (%)	-
	Residents with college degrees (%)	+
	Population over 64 or below 6 (%)	-
	Median household income. (1,000 dollars)	+
Neighborhood Built Environment		
	Population density (per square kilometer).	+
Weather Conditions		
	Recorded high temperature.(in Celsius)	+
	Deviation from the 30-year normal temperature	+/-
	Precipitation.(centimeters)	-
	Average wind speed. (kph)	-
Temporal Dummies		
	Saturday or Sunday (equals 1, otherwise 0)	+

Modeling Mixed-mode Trail Traffic

(Wang et al. 2013)



Modeling Choices Affect Accuracy of Estimates

Site	Model Type	Mean Daily Traffic	Land Use Model General		Six Location Model		Trail Specific Models	
			Predict	Error	Predict	Error	Predict	Error
Hennepin	NB2	2496	2393	8.3	2271	10.5	2229	11.4
	OLS		2703	19.4	2670	18.3	2760	19.4
WRP	NB2	1188	1014	17.2	1017	17.0	1022	16.5
	OLS		1454	27.3	1458	27.7	1277	20.6
Cedar	NB2	2871	2606	13.8	2610	13.7	2351	17.3
	OLS		2730	10.1	2732	10.2	2843	9.9
Calhoun	NB2	4103	3649	20.7	3679	20.7	3982	14.3
	OLS		4033	44.1	4037	44.2	4704	38.0
Nokomis	NB2	1430	1689	22.5	1703	23.5	1657	19.4
	OLS		2082	55.9	2085	56.2	1975	47.1
Wirth	NB2	419	338	17.4	342	17.1	368	12.1
	OLS		1048	151.5	1051	152.6	471	32.6
Grand Mean Error NB (%)			16.6		17.1		15.2	
Grand Mean Error OLS (%)			51.4		51.5		27.9	

Observations from Modeling

- Possible to identify factors associated with higher non-motorized trail volumes
- Trail models do reasonable job estimating volumes (± 15-20%)
- Modeling choices affect accuracy
- Models can be improved with better specification and additional data

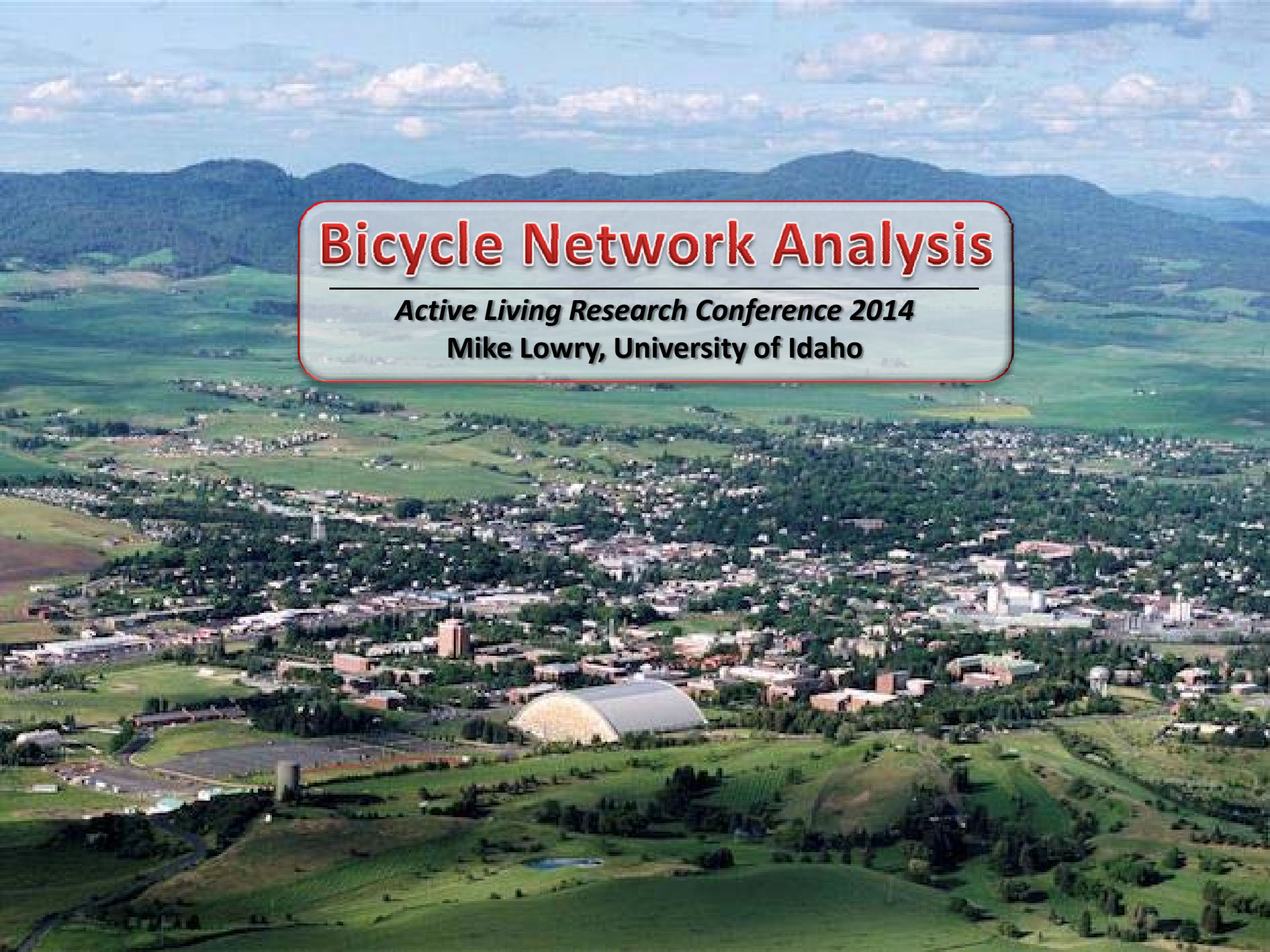
TMAP Trail Monitoring: Building on Experience

1. Purpose	• Develop national trail model, factors for all climatic regions • Estimates of average annual daily trail traffic, miles traveled
2. Locations	• 9 regions, 10-12 cities, 25-30 locations
3. Technologies	• Eco-multi counters (inductive loop and passive infrared, separate bike and ped counts)
4. QA/QC	• On-site calibration, outliers, correction for occlusion, systematic error
5. Analytics	• Two-step factoring, day-of-year factors
6. Modeling	• Negative binomial land use regression, weather controls
7. Sustainability	• Collaboration, local partners

Questions?

For more information contact:

Greg Lindsey (linds301@umn.edu)



Bicycle Network Analysis

Active Living Research Conference 2014

Mike Lowry, University of Idaho

Outline

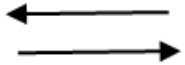
1. Conducting citizen-volunteer count programs.

2. Estimating network-wide bicycle volumes.

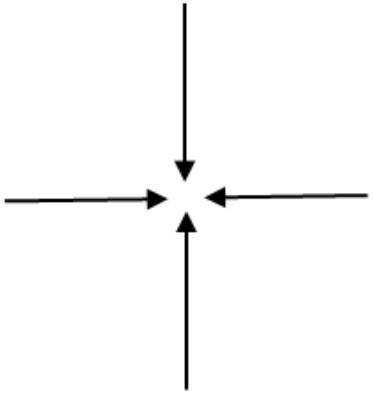
3. Prioritizing projects based on connectivity.

CONDUCTING CITIZEN-VOLUNTEER COUNT PROGRAMS

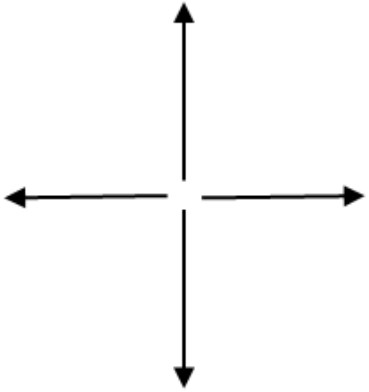
2 Movement
Screenline



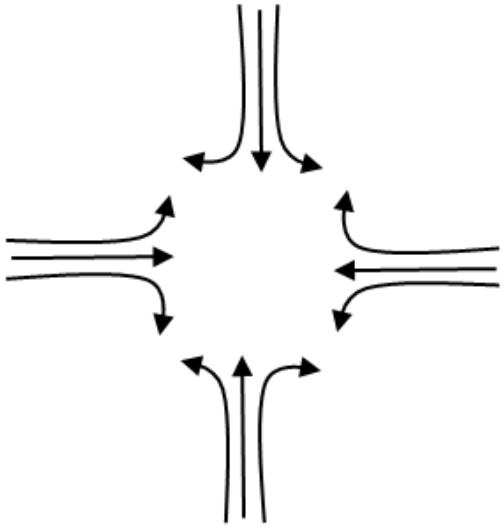
4 Movement
Toward Intersection

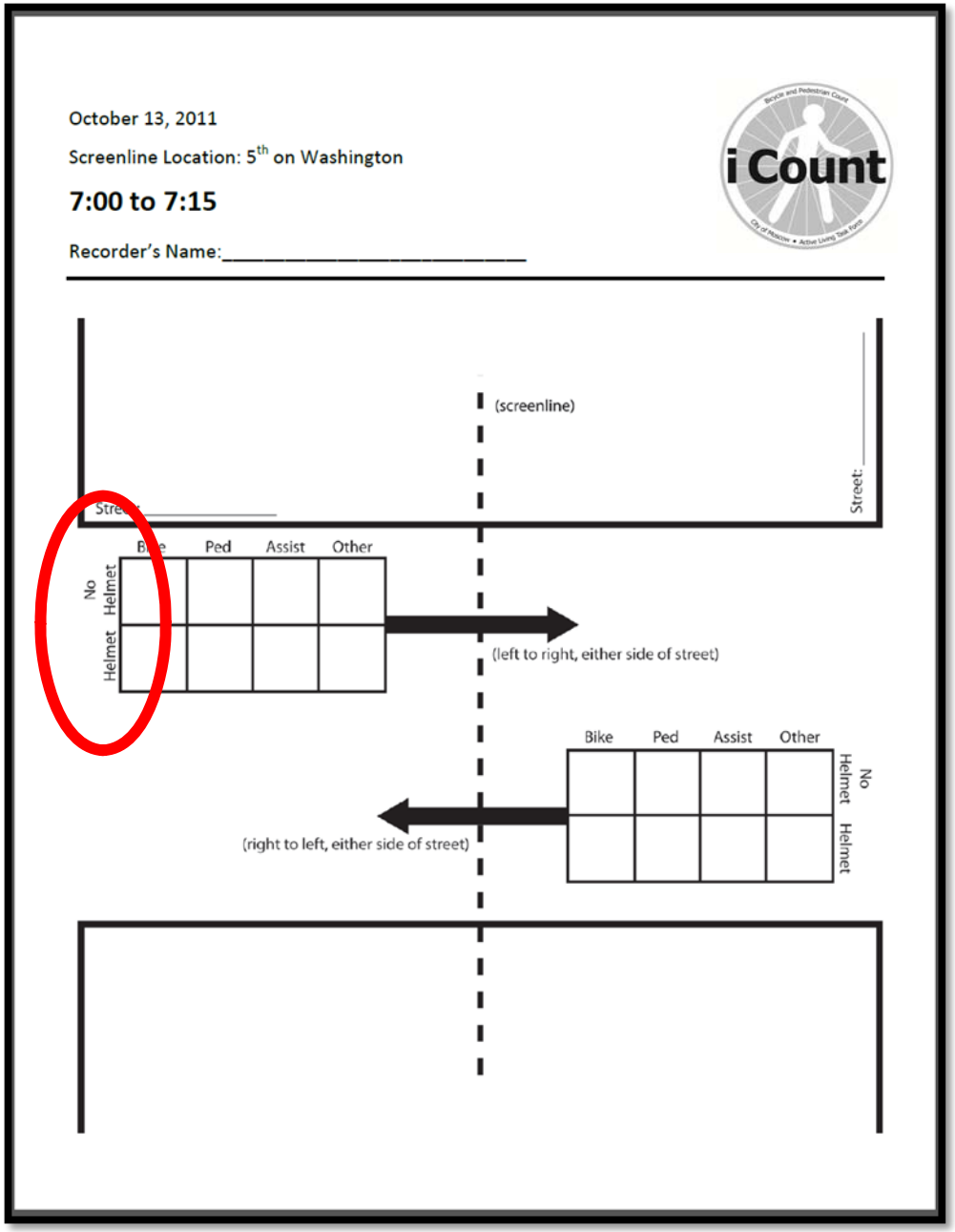


4 Movement
Leaving Intersection



12 Movement





Screenline Additional

- Helmet/No Helmet
- Male/Female
- Adult/Child
- Street/Sidewalk

Citizen Volunteer Counts

2012 Washington State Bicycle and Pedestrian Documentation Project

Table 2: Count cities and locations by year

	2008		2009		2010		2011		2012	
City	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Bainbridge Island	0	0	0	0	0	5	1	1	5	4
Bellevue	4	3	13	13	13	13	5	7	7	8
Bellingham	6	6	12	12	17	17	18	18	18	18
Bothell	5	6	6	4	6	3	6	5	6	5
Bremerton	6	6	6	4	6	5	1	3	6	5
Burien	0	0	4	9	9	9	9	9	10	10
Ellensburg	6	4	5	4	2	3	3	5	4	4
Everett	6	6	9	9	8	5	10	9	11	11
Federal Way	0	0	0	0	0	0	0	0	1	5
Ferndale	1	1	0	0	1	0	0	0	0	0
Gig Harbor	0	0	0	0	0	0	0	0	1	1
Issaquah	0	0	6	4	7	3	6	3	6	6
Kelso	0	0	5	7	8	8	0	1	2	0
Yakima	3	3	1	1	1	2	2	3	1	1
Total	91	92	152	149	184	182	191	176	202	207
	183		301		366		367		409	

Table 2: Count cities and locations by year

National Bicycle and ×

www.bikepedocumentation.org

Home Participate Downloads

Count Dates:

The next count/survey days are **May 6-8, 2014**.
Upcoming days through 2014 are:

- May 6-8, 2014
- July 4-6, 2014
- Sept 9-14, 2014

Stay tuned for the next round of count days!

About

One of the greatest challenges facing the bicycle and pedestrian field is the lack of documentation on usage and demand. Without accurate and consistent demand and usage figures, it is difficult to measure the positive benefits of investments in these modes, especially when compared to the other transportation modes such as the private automobile. An answer to this need for data is the National Bicycle & Pedestrian Documentation Project, co-sponsored by and Alta Planning and Design and the Institute of Transportation Engineers (ITE) Pedestrian and Bicycle Council. This nationwide effort provides consistent model of data collection and ongoing data for use by planners, governments, and bicycle and pedestrian professionals.

Methodology

The basic assumptions of the methodology are that, in order to estimate existing and future bicycle and pedestrian demand and activity, agencies nationwide need to start conducting counts and surveys in a consistent manner similar to those being used by ITE and other groups for motor vehicle models.

NBPD to Provide Free Summary Reports!

The National Bicycle and Pedestrian Documentation Project has developed a summary report that highlights the valuable information that can be gained from year-long automatic bicycle and pedestrian counts. If your community uses Eco-Counter automatic count technology, the National Bicycle and Pedestrian Documentation Project will provide a free summary report of the data in exchange for submission of the annual automatic count data to the project. This report puts valuable information regarding usage and trends at your fingertips which can be used in grant applications, press releases, annual count reports, etc. Sample reports are available here and here. Email your Eco-Counter data in excel format to data@bikepeddocumentation.org. Please indicate the exact location of the automatic counter and tell us a bit about the bicycle or pedestrian facility.

News

- Adjustment Factors Available: Adjustment factors are now availabe in an Excel format! While more year-long automatic count

Instructions

The other dates were selected to provide a representative sampling of activity during a typical spring (May) and winter (January) period. The 4th of July period was selected because it will afford both a typical summer weekday and what is typically the busiest holiday period and activity period for recreational facilities and activities.

Having an official count week is also important for generating enthusiasm around the date. Much like nationwide Bike to Work Weeks, we hope that the National Documentation Project Week in September will become a much-anticipated annual event in localities around the nation.

Times

Based on our research, we are recomme
below). However, if you have been doin
using these same time periods for all fut

RECOMMEN
Weekday, 5-
Saturday, 12

SECONDARY
Weekday, 7
Saturday, 7 A

Rationale for Time Periods

Time periods are more important for co
periods were chosen since the afternoo
travelers, with commuters, school childr
conducted during these periods will pro
bicycling during the peak periods of the
peak period. Actual local peak periods n
that the national count time periods be
periods if it is determined that this perio

Automatic Machines

While the NBPD is based on manual cou
conducting counts to consider conductin
community. These machines will give in
usage, benefits and other information.

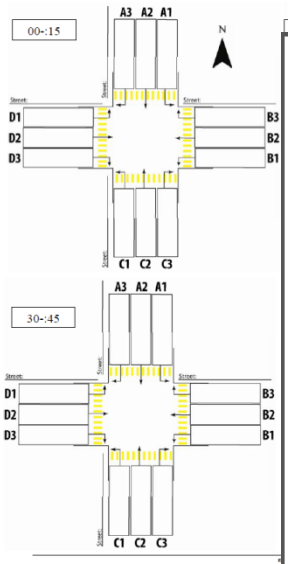
Weather

Weather may be a determinant in select
conduct counts and surveys, but a partic
poor or unusual during the count period

Forms

Please fill in your name, count location, date, time period, and weather conditions (fair, rainy, very cold). Count all bicyclists crossing through the intersection under the appropriate categories.

- Count for two hours in 15-minute increments.
- Count bicyclists who ride on the sidewalk.
- Count the number of people on the bicycle, not the number of bicycles.
- Use one intersection graphic per 15-minute interval.



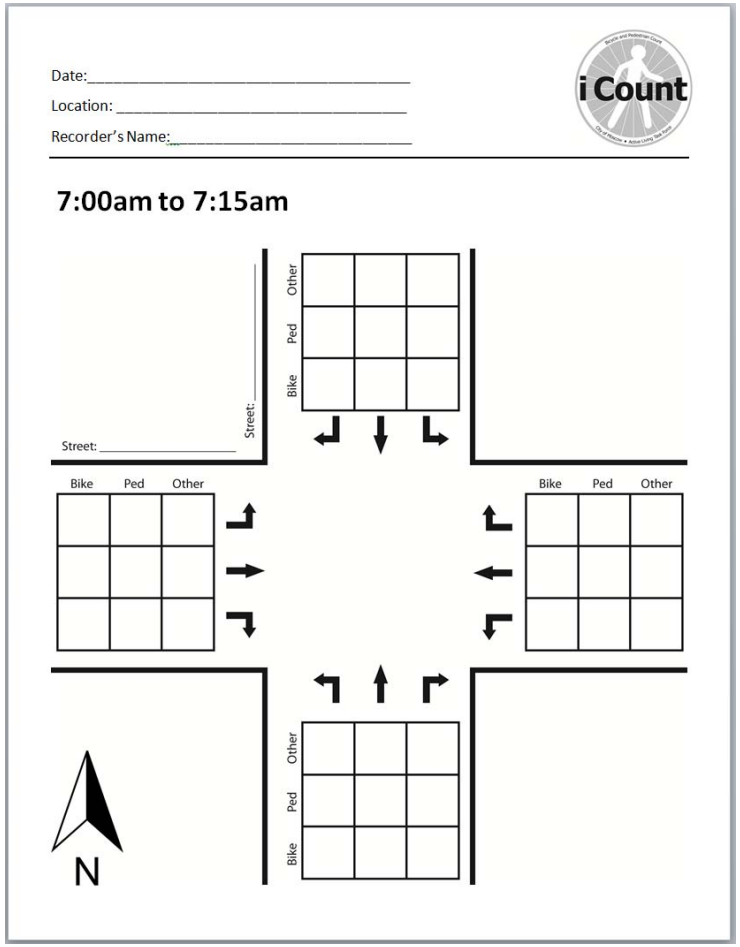
Training Presentation

How do you count this?

alta PLANNING + DESIGN

Recommendations

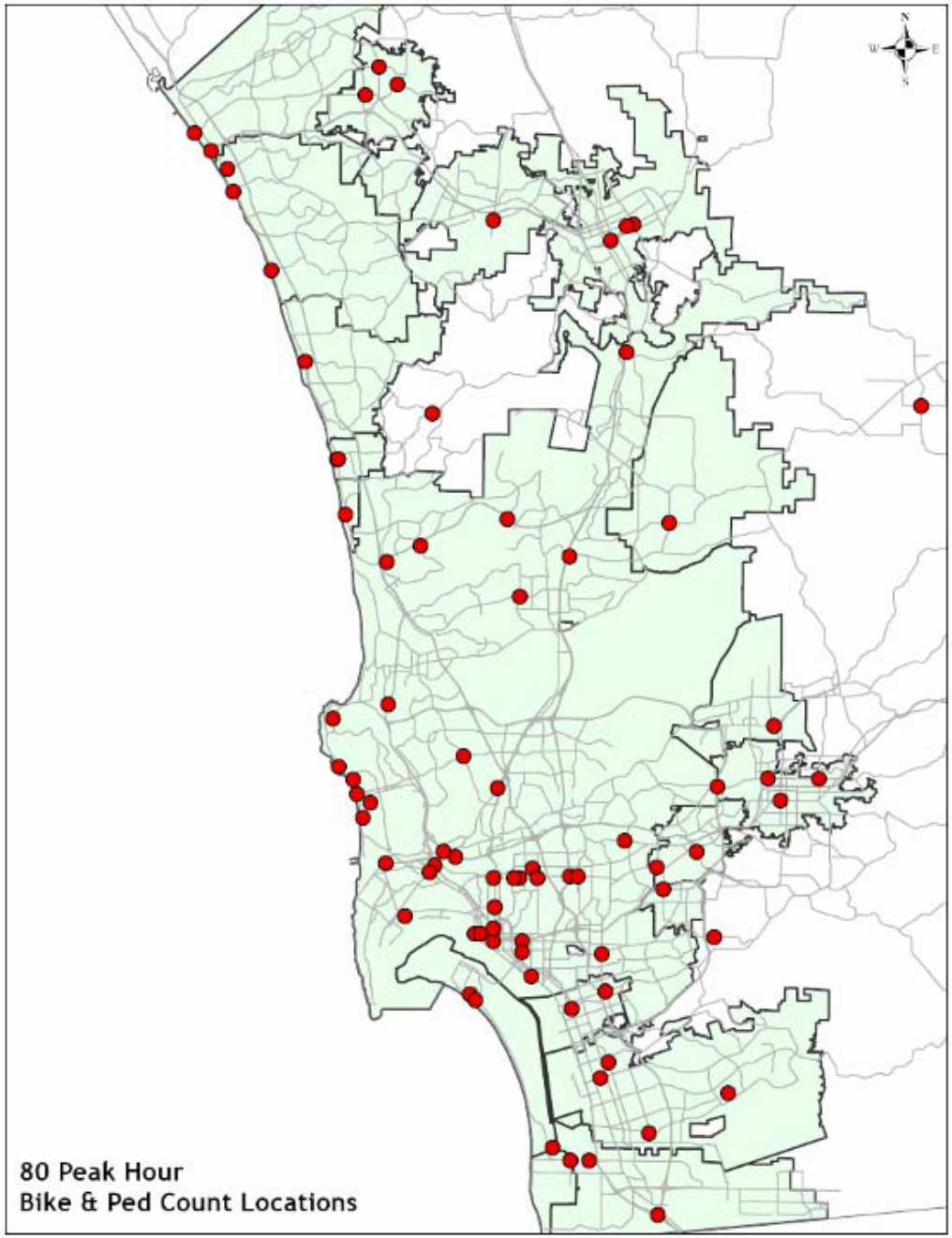
- Create your own forms
- Enhance the training
- Customize the experience
- Define the purpose and stay focused

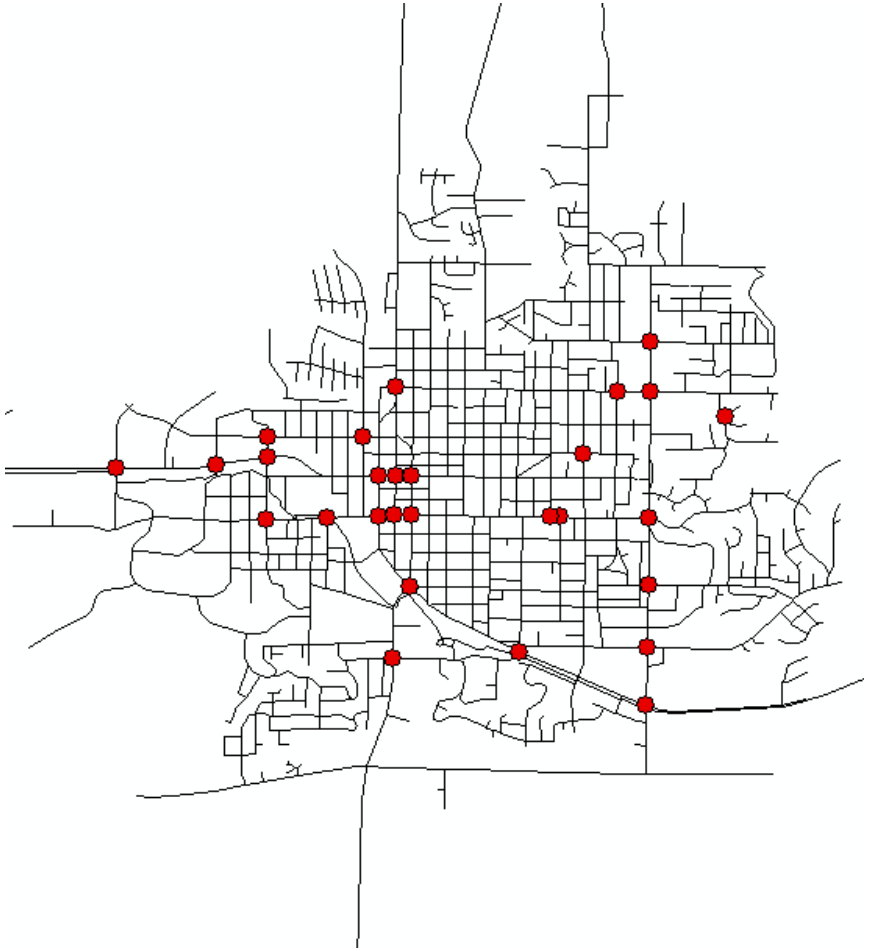


Purpose?

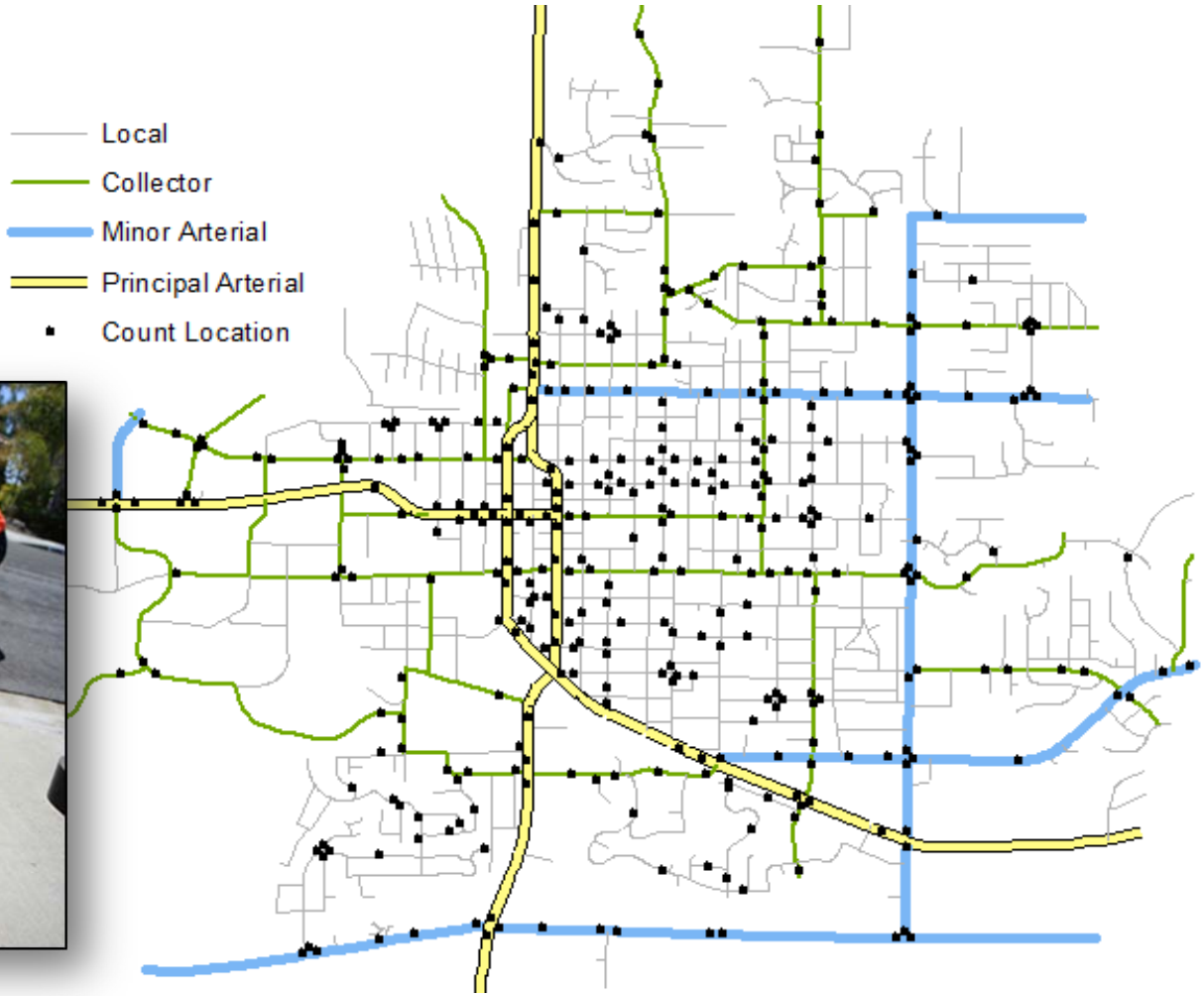
Purpose	Yes/No/Maybe
Raising awareness about bicycle and pedestrian activity	
Providing public engagement and outreach	
Getting a snap shot of community-wide biking/walking	
Applying for grants	
Analyzing trends year-to-year	
Making comparisons with other communities	
Determining percentage of bicycle and pedestrian travel	
Making adjustments to traffic signal timing	
Improving signage	
Making infrastructure improvments	
Improving paint markings	
Safety analysis	
Project selection	
Project evaluation (before and after studies)	
Identifying bike/ped characteristics (Helmet/No Helmet etc.)	

80 locations!





- **26 Locations**
- **2011, 2012, 2013**
- **7:00 – 9:00 AM**
- **4:00 – 6:00 PM**



341 locations

Three day tube counters for cars

Sixth_Hayes_West.xls [Compatibility Mode] - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer Add-Ins Acrobat

A830 | 10/10/2013

	A	B	C	D	E
1	Date	TimePeriod	Movement	Mode	Count
812	10/10/2013	5:30-5:45 PM	NBL	Pedestrian	0
813	10/10/2013	5:30-5:45 PM	NBT	Pedestrian	0
814	10/10/2013	5:30-5:45 PM	NBR	Pedestrian	0
815	10/10/2013	5:30-5:45 PM	WBL	Pedestrian	0
816	10/10/2013	5:30-5:45 PM	WBT	Pedestrian	1
817	10/10/2013	5:30-5:45 PM	WBR	Pedestrian	0
818	10/10/2013	5:30-5:45 PM	SBR	Bicycle	0
819	10/10/2013	5:30-5:45 PM	SBT	Bicycle	0
820	10/10/2013	5:30-5:45 PM	SBL	Bicycle	0
821	10/10/2013	5:30-5:45 PM	EBL	Bicycle	0
822	10/10/2013	5:30-5:45 PM	EBT	Bicycle	0
823	10/10/2013	5:30-5:45 PM	EBR	Bicycle	0
824	10/10/2013	5:30-5:45 PM	NBL	Bicycle	0
825	10/10/2013	5:30-5:45 PM	NBT	Bicycle	0
826	10/10/2013	5:30-5:45 PM	NBR	Bicycle	0
827	10/10/2013	5:30-5:45 PM	WBL	Bicycle	0
828	10/10/2013	5:30-5:45 PM	WBT	Bicycle	1
829	10/10/2013	5:30-5:45 PM	WBR	Bicycle	0
830	10/10/2013	5:45-6:00 PM	SBR	Other	0
831	10/10/2013	5:45-6:00 PM	SBT	Other	0
832	10/10/2013	5:45-6:00 PM	SBL	Other	0
833	10/10/2013	5:45-6:00 PM	EBL	Other	0
834	10/10/2013	5:45-6:00 PM	EBT	Other	0
835	10/10/2013	5:45-6:00 PM	EBR	Other	0
836	10/10/2013	5:45-6:00 PM	NBL	Other	0
837	10/10/2013	5:45-6:00 PM	NBT	Other	0
838	10/10/2013	5:45-6:00 PM	NBR	Other	0
839	10/10/2013	5:45-6:00 PM	WBL	Other	0
840	10/10/2013	5:45-6:00 PM	WBT	Other	0
841	10/10/2013	5:45-6:00 PM	WBR	Other	0
842	10/10/2013	5:45-6:00 PM	SBR	Pedestrian	0
843	10/10/2013	5:45-6:00 PM	SBT	Pedestrian	0
844	10/10/2013	5:45-6:00 PM	SBL	Pedestrian	0
845	10/10/2013	5:45-6:00 PM	EBL	Pedestrian	0
846	10/10/2013	5:45-6:00 PM	EBT	Pedestrian	0
847	10/10/2013	5:45-6:00 PM	EBR	Pedestrian	0

Information Data Chart

Ready 100%

iCount Data Entry Form

Numerical Date 01/01/2011:

Date:

Select 15 Minute Increment:

Morning Shift:

- 7:00 - 7:15 AM
- 7:15 - 7:30 AM
- 7:30 - 7:45 AM
- 7:45 - 8:00 AM
- 8:00 - 8:15 AM
- 8:15 - 8:30 AM
- 8:30 - 8:45 AM
- 8:45 - 9:00 AM

Evening Shift:

- 4:00 - 4:15 PM
- 4:15 - 4:30 PM
- 4:30 - 4:45 PM
- 4:45 - 5:00 PM
- 5:00 - 5:15 PM
- 5:15 - 5:30 PM
- 5:30 - 5:45 PM
- 5:45 - 6:00 PM

Other:	0	0	0
Pedestrian:	0	0	0
Bicyclist:	0	0	0

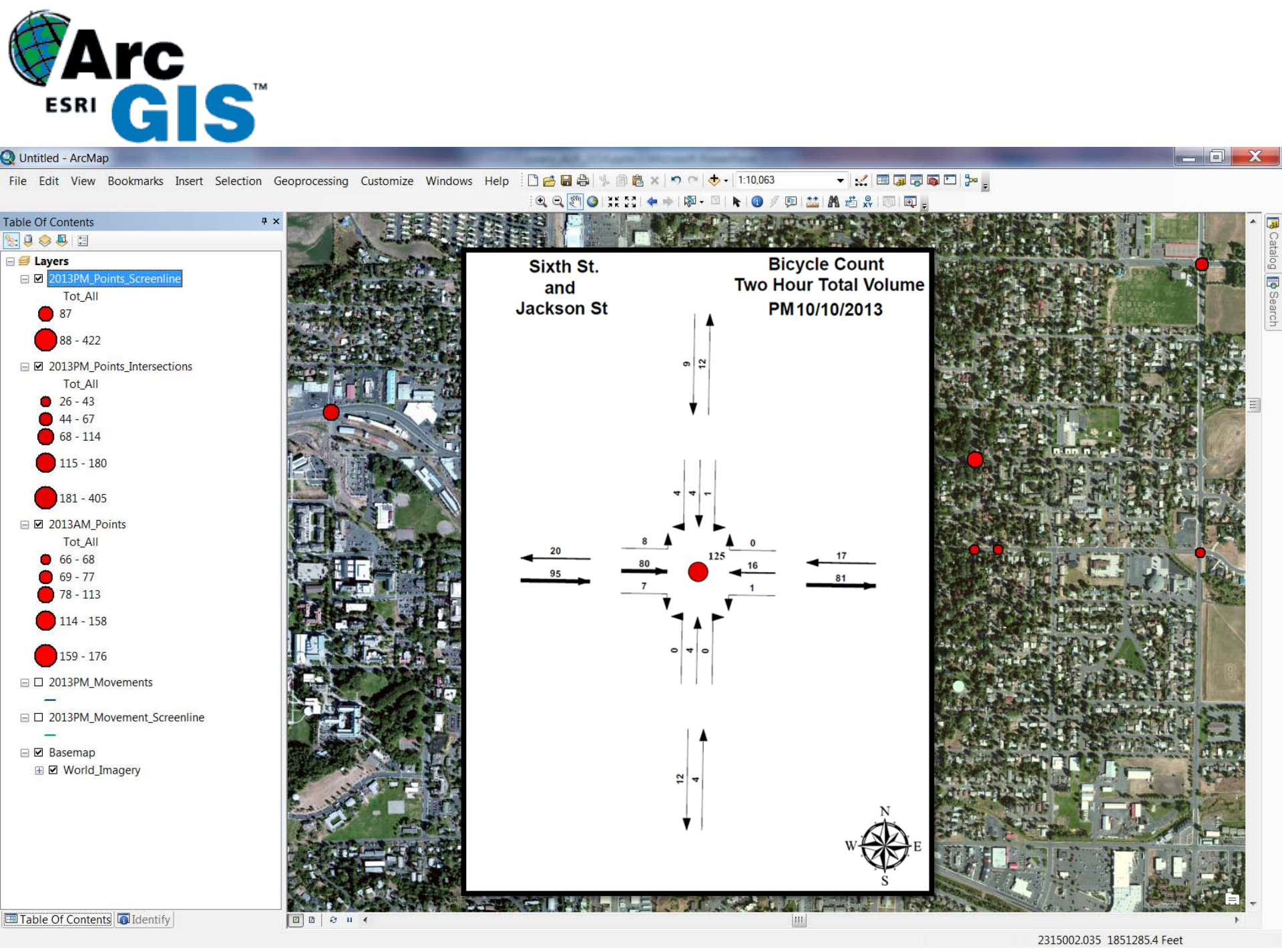
	Bike:	Ped:	Other:
	0	0	0
	0	0	0
	0	0	0

	Bike:	Ped:	Other:
	0	0	0
	0	0	0
	0	0	0

N

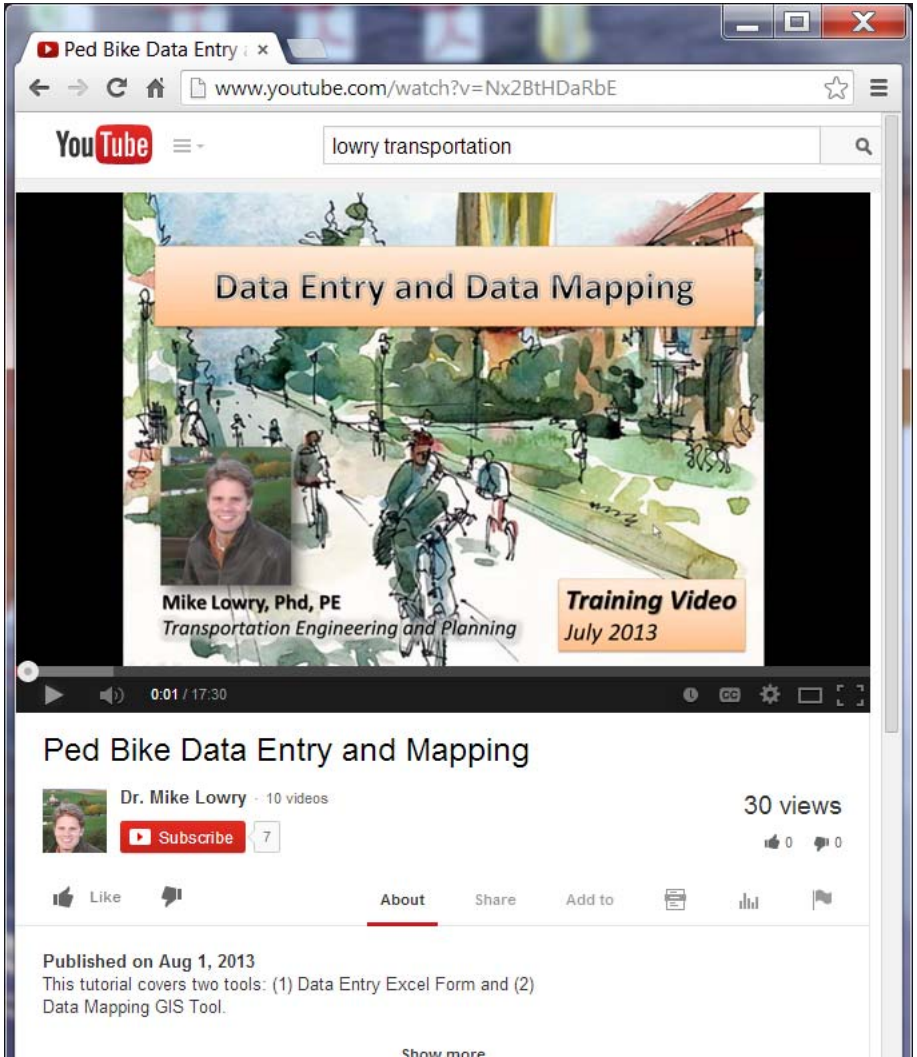
Other:	0	0	0
Ped:	0	0	0
Bike:	0	0	0

Clear Form Data | Submit Data | Close

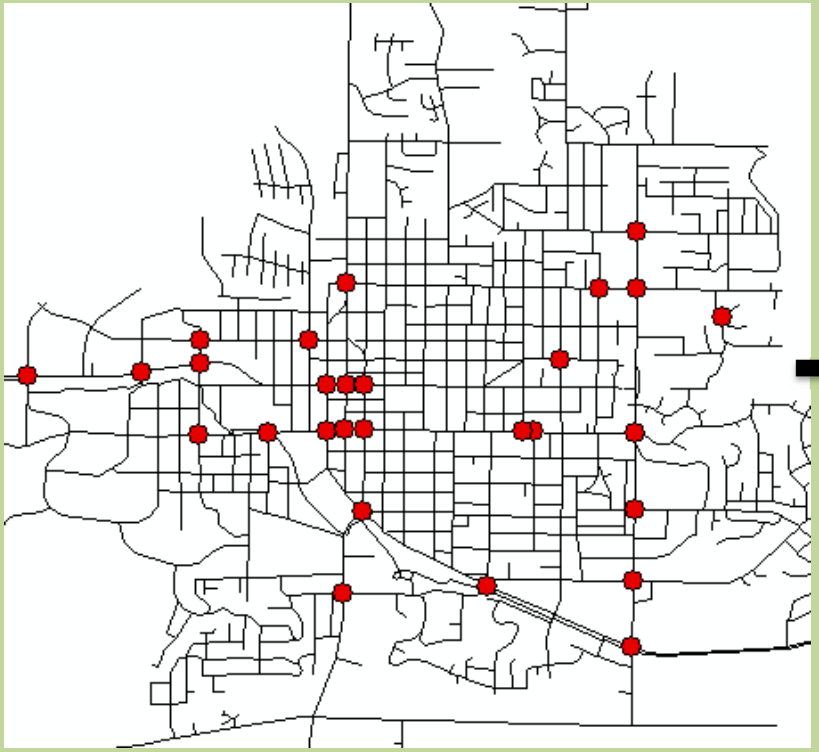

ArcGIS
ESRI
Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:10,063
Table Of Contents
Layers
2013PM_Points_Screenline
Tot_All
87
88 - 422
2013PM_Points_Intersections
Tot_All
26 - 43
44 - 67
68 - 114
115 - 180
181 - 405
2013AM_Points
Tot_All
66 - 68
69 - 77
78 - 113
114 - 158
159 - 176
2013PM_Movements
2013PM_Movement_Screenline
Basemap
World_Imagery
Table Of Contents
Identify
Sixth St.
and
Jackson St
Bicycle Count
Two Hour Total Volume
PM 10/10/2013
9
12
4
4
1
8
0
20
125
17
80
16
95
81
7
1
0
4
0
12
4
N
W
E
S
Catalog
Search
2315002.035 1851285.4 Feet

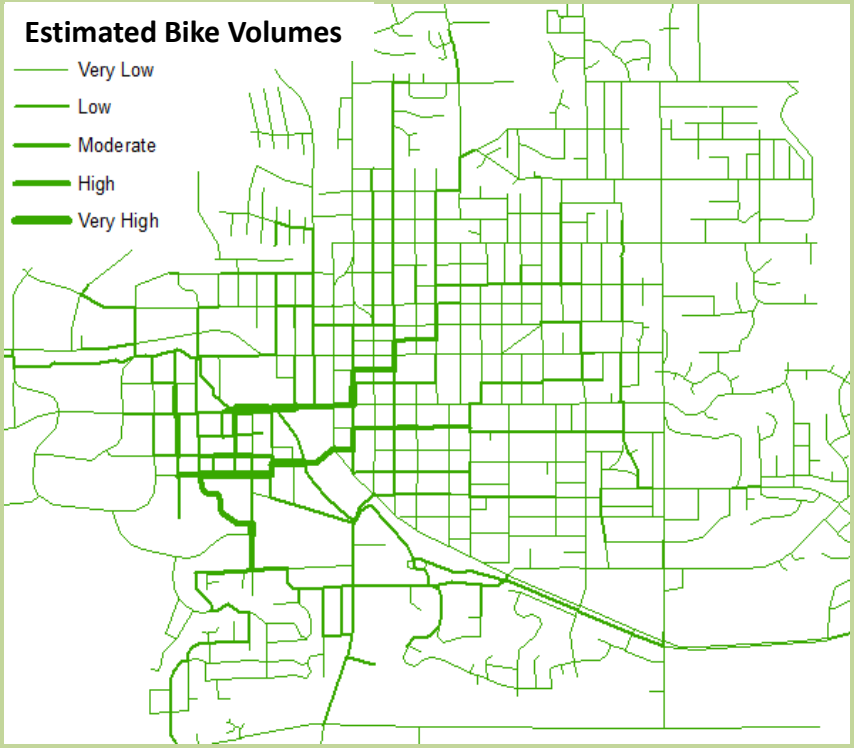
[Data Entry and Mapping Demonstration video]

http://www.youtube.com/watch?v=Nx2BtHDaRbE



ESTIMATING NETWORK-WIDE BICYCLE VOLUMES



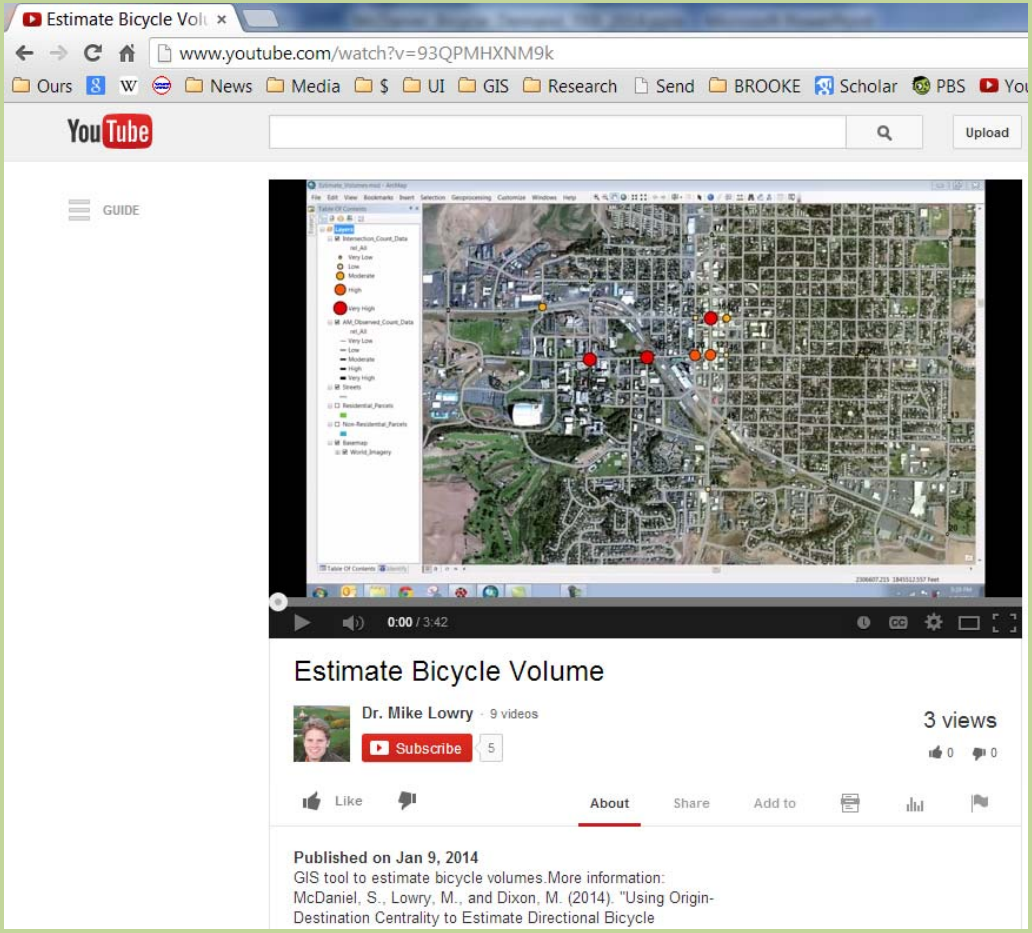


Observed Count Points

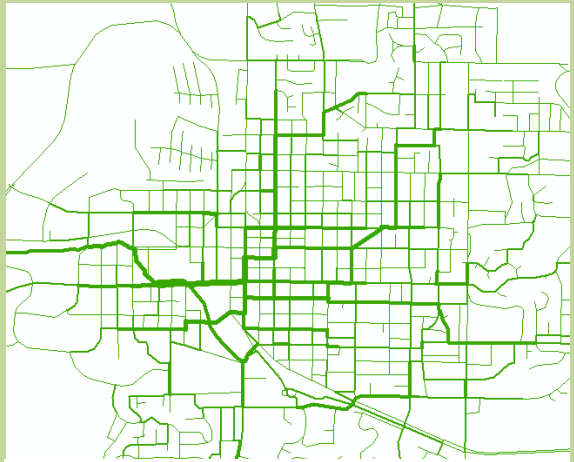
Network-wide 2 Hour Volume

[Volume Estimation Demonstration video]

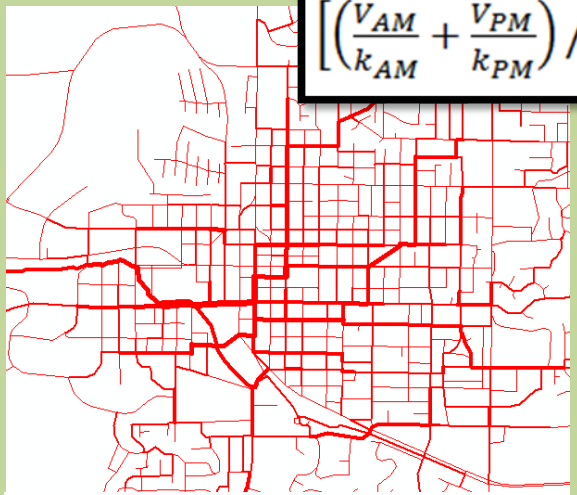
http://www.youtube.com/watch?v=dMp2XIQaykw



Step 1. Spatially Extrapolate



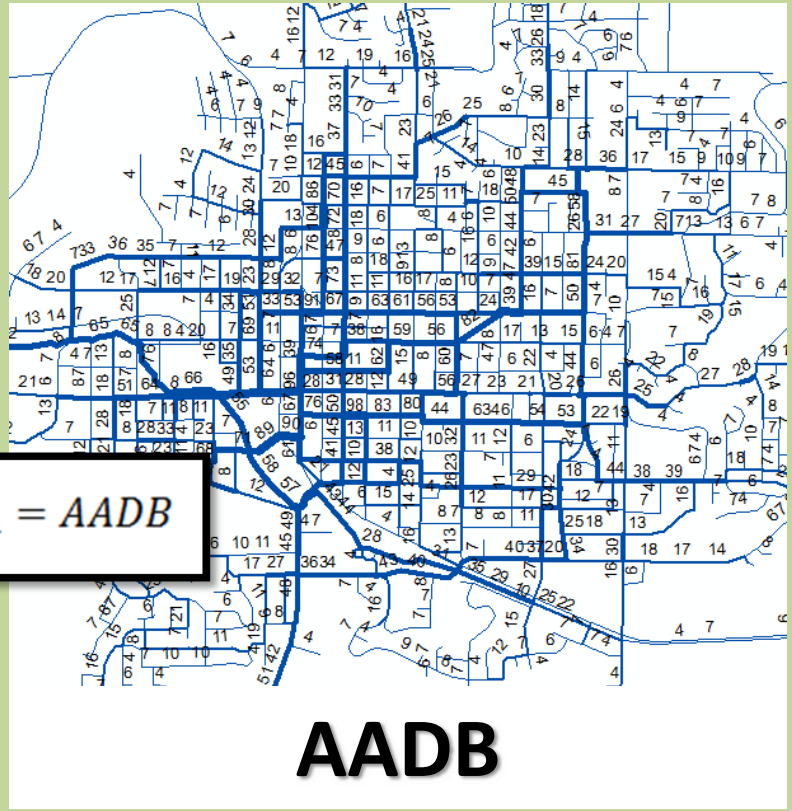
AM 2 Hour Volume



PM 2 Hour Volume

$$\left[\left(\frac{V_{AM}}{k_{AM}} + \frac{V_{PM}}{k_{PM}}\right)/2\right] * F_{day} * F_{month} = AADB$$

Step 2. Temporally Extrapolate



AADB

Scenario Planning

Scenario Planning

Third Street Bicycle Volumes Existing and Forecasted

Intersection Cross Street	Existing Conditions (AADB)	Proposed Scenario (AADB)
Van Buren Street	24	226
Harrison Street	28	230
Tyler Street	32	230
Polk Street	44	253
Taylor Street	89	239
Fillmore Street	127	255
Pierce Street	146	255

Increase of about 200 bicyclists per day.

Increase of about 150 bicyclists per day.

PRIORITIZING PROJECTS BASED ON CONNECTIVITY

- **Bicycle Suitability**

  Perceived comfort and safety of a segment of street or pathway

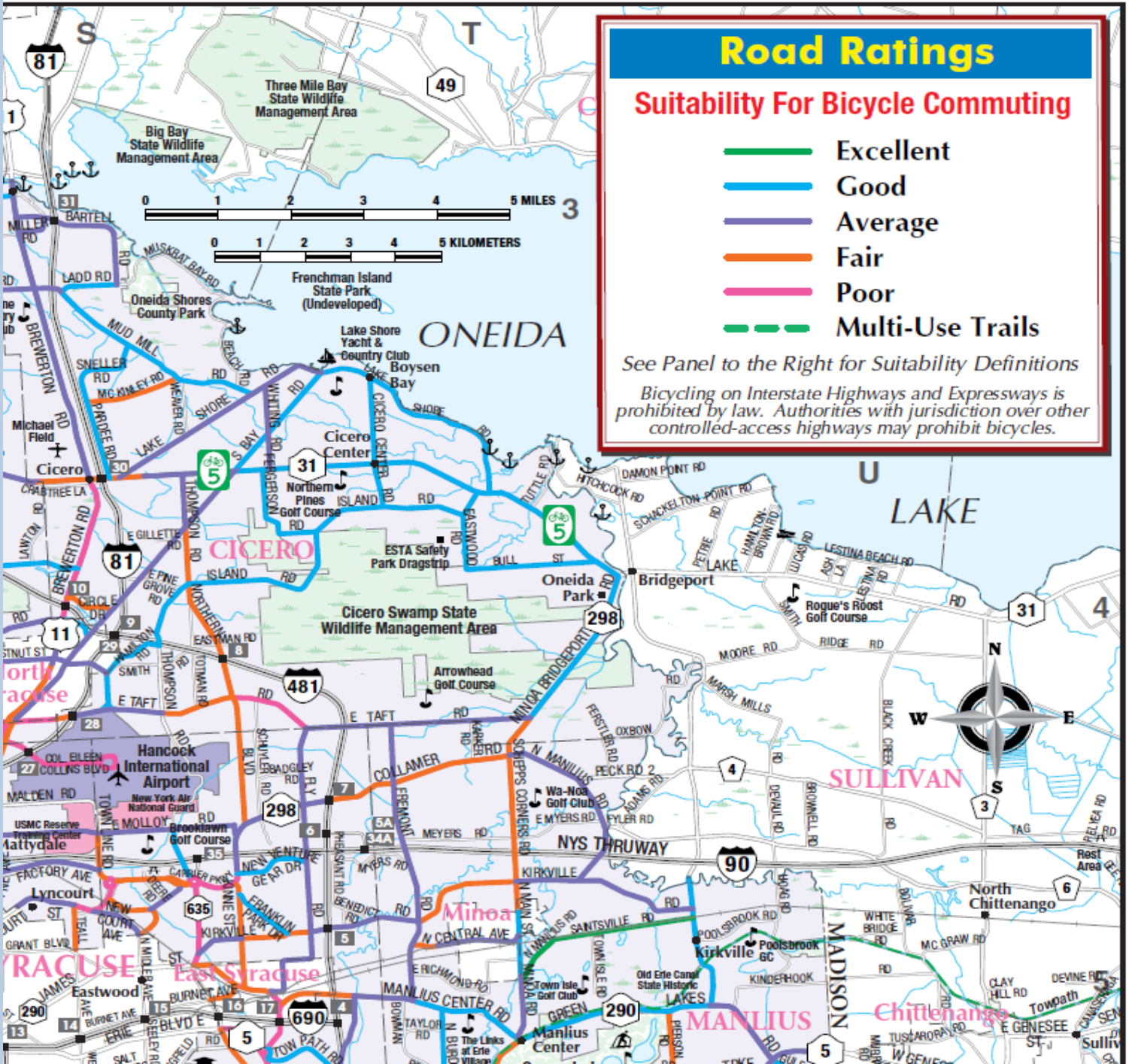
- **Bikeability**

  Perceived comfort and safety of network connectivity for accessing important destinations

- **Bicycle Friendliness**

  Perceived comfort and safety of all aspects of bicycle travel, including bikeability, laws and policies to promote bicycling, education efforts to encourage bicycling, and general acceptance of bicycling throughout the community

Name of Method	Acronym	Author	Date
Bicycle Safety Index Rating	BSIR	Davis	1987
Bicycle Stress Level	BSL	Sorton and Walsh	1994
Road Condition Index	RCI	Epperson	1994
Interaction Hazard Score	HIS	Landis	1994
Bicycle Suitability Rating	BSR	Davis	1995
Bicycle Level of Service	BLOS	Botma	1995
Bicycle Level of Service	BLOS	Dixon	1996
Bicycle Suitability Score	BSS	Turner et al	1997
Bicycle Compatibility Index	BCI	Harkey et al	1998
Bicycle Suitability Assessment	BSA	Emery and Crump	2003
Rural Bicycle Compatibility Index	RBCI	Jones	2003
Compatibility of Roads for Cyclists	CRC	Noel et al	2003
Bicycle Level of Service	BLOS	Zolnik	2007
Bicycle Level of Service	BLOS	Jensen	2007
Bicycle Level of Service	BLOS	Petritsch et al	2007
Bicycle Environmental Quality Index	BEQI	SFDPH	2009
Bicycle Quality Index	BQI	Birk et al	2010
Bicycle Level of Service	BLOS	HCM	2011
Bicycle Levels of Traffic Stress	LTS	Mekuria and Furth	2012

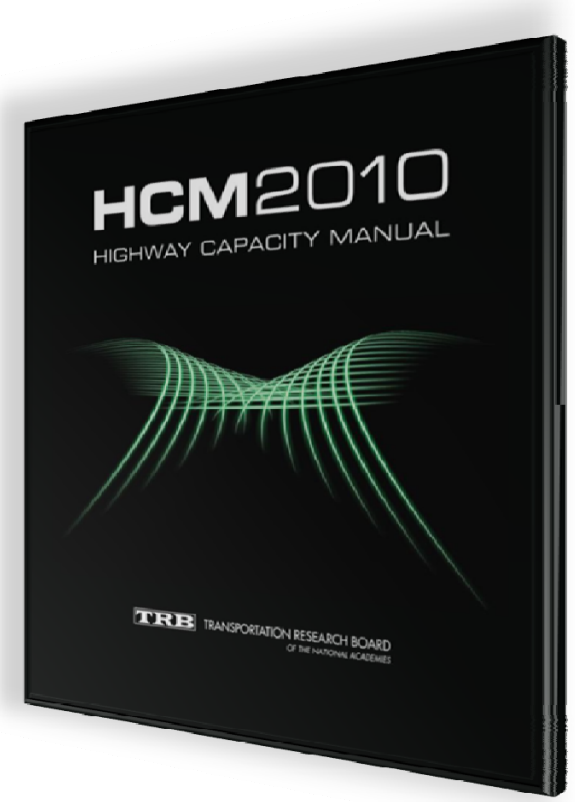

Road Ratings
Suitability For Bicycle Commuting
Excellent
Good
Average
Fair
Poor
Multi-Use Trails
See Panel to the Right for Suitability Definitions
Bicycling on Interstate Highways and Expressways is prohibited by law. Authorities with jurisdiction over other controlled-access highways may prohibit bicycles.
Three Mile Bay State Wildlife Management Area
Big Bay State Wildlife Management Area
Frenchman Island State Park (Undeveloped)
Oneida Shores County Park
ONEIDA
Lake Shore Yacht & Country Club
Boysen Bay
Cicero Center
Northern Pines Golf Course
CICERO
ESTA Safety Park Dragstrip
Cicero Swamp State Wildlife Management Area
Arrowhead Golf Course
Oneida Park
Bridgeport
Rogue's Roost Golf Course
LAKE
SULLIVAN
Hancock International Airport
New York Air National Guard
USMC Reserve Training Center
Brooklawn Golf Course
Wa-Nee Golf Club
NYS THRUWAY
Lyncourt
Minoa
North Chittenango
Kirkville
Poolsbrook GC
Town Isle Golf Club
Old Erie Canal State Historic
LAKES
MANLIUS
Manlius Center
The Links at Erie Village
MADISON
Chittenango
Eastwood
East Syracuse
SYRACUSE
Mattydale
5 MILES
5 KILOMETERS

Equation

$$\textit{Bicycle Level of Service} = 0.76 + [-0.005((w_{ol} + w_{bl} + w_{os})(2 - 0.005v) + (w_{bl} + w_{os} - 20p_{pk}) - 1.5c)^2] + 0.507 \ln\left(\frac{v}{4N_{th}}\right) + 0.199[1.119 \ln(S - 20) + 0.8103](1 + 0.1038P_{HV})^2 + 7.066\left(\frac{1}{P_c^2}\right)$$

Input

Attribute	Description
wol	width of outside lane (ft)
wbl	width of bike lane (ft)
wos	width of outside shoulder including parking and gutter (ft)
ppk	estimated proportion of on-street parking that would be occupied during analysis period (decimal)
c	curb present (yes = 1, no =0)
v	directional analysis period vehicle volume (vph)
Nth	number of through lanes (#)
S	average vehicle speed (mph)
PHV	percent heavy vehicles (decimal)
Pc	pavement condition (poor-excellent) (0-5)

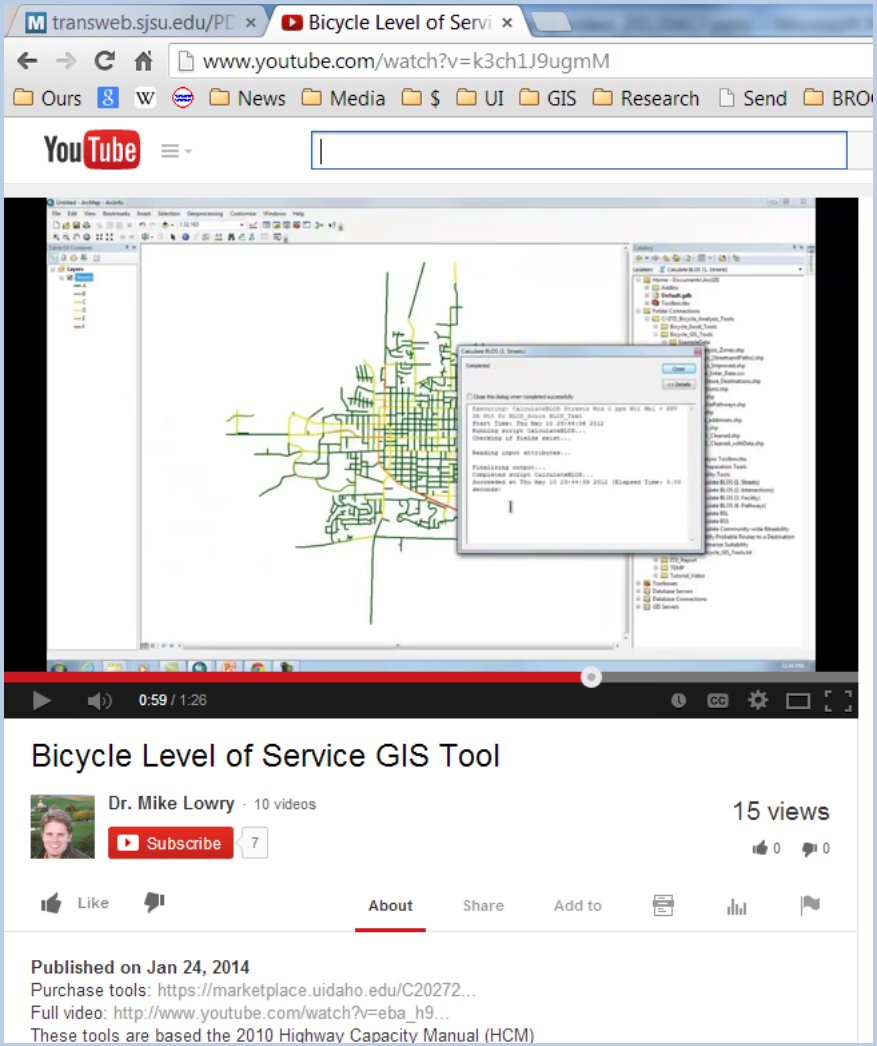


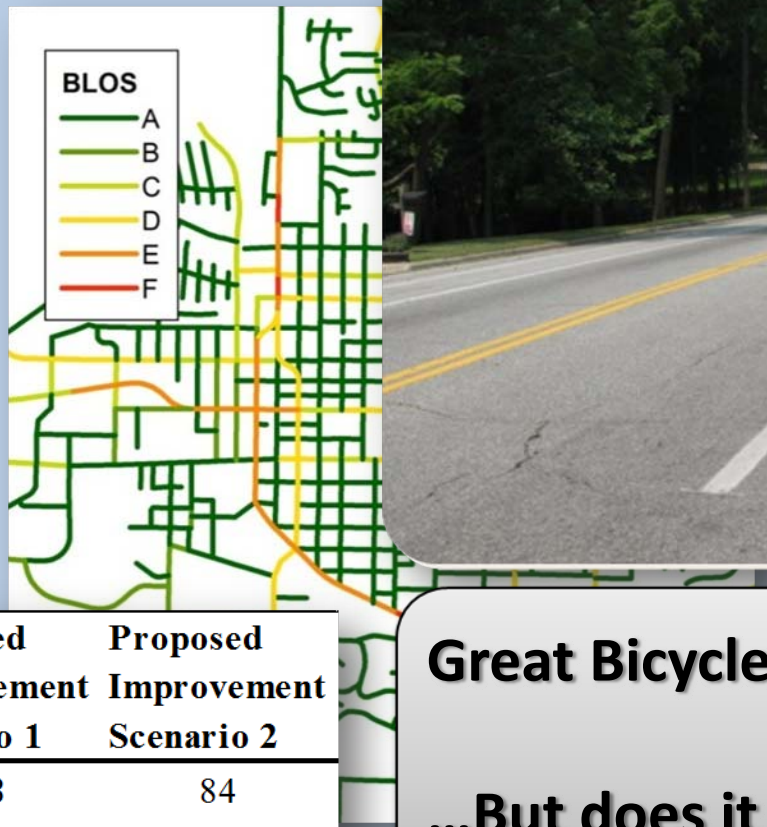
Output

BLOS	Letter Grade
≤ 2.00	A
2.00-2.75	B
2.75-3.50	C
3.50-4.25	D
4.25-5.00	E
>5.00	F

[BLOS Demonstration video]

http://www.youtube.com/watch?v=k3ch1J9ugmM





BLOS	Current Conditions	Proposed Improvement Scenario 1	Proposed Improvement Scenario 2
A	70	78	84
B	7	8	5
C	10	8	5
D	7	3	3
E	3	1	1
F	3	2	2

Great Bicycle Suitability…

…But does it go anywhere?

- **Bicycle Suitability**

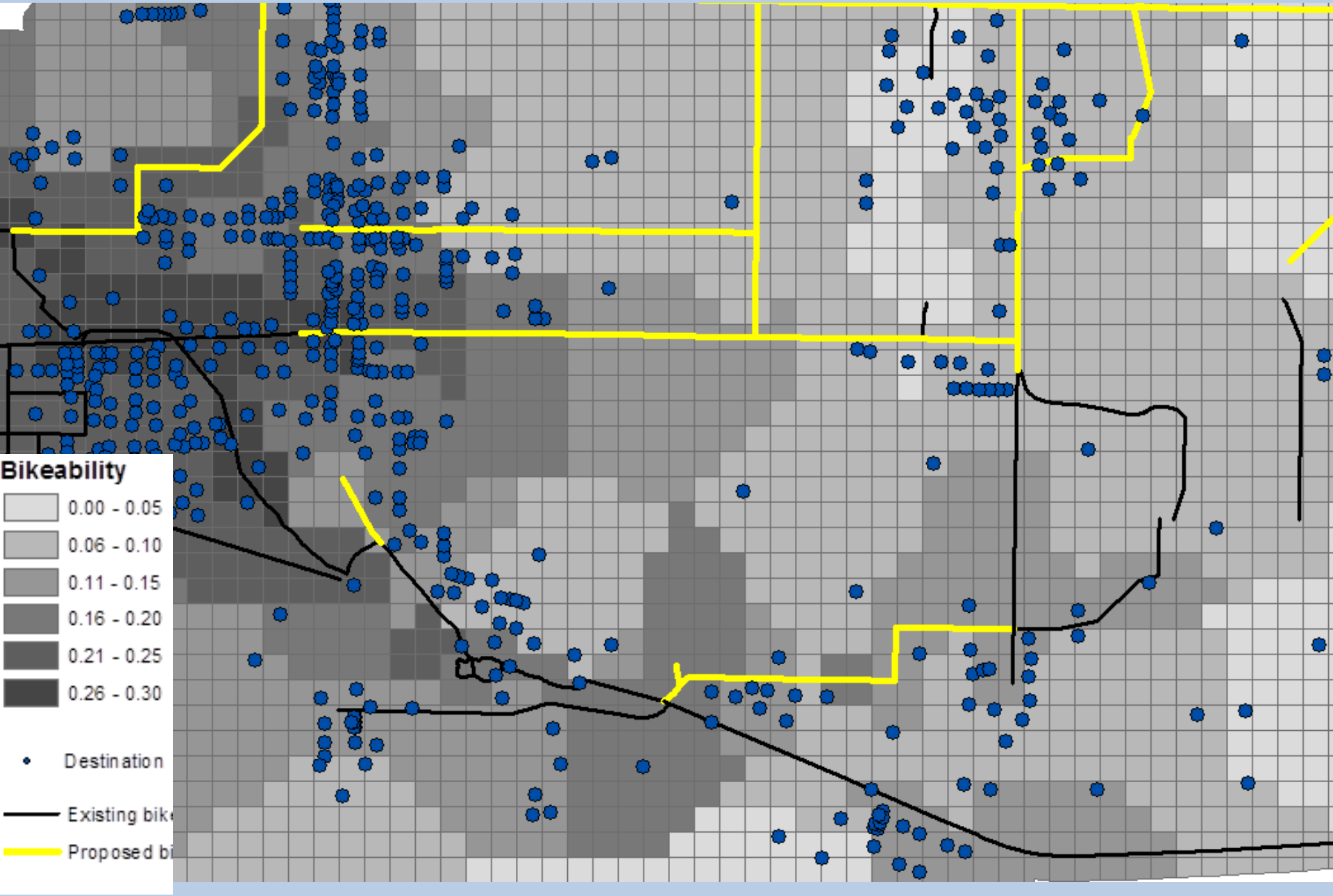
  Perceived comfort and safety of a segment of street or pathway

- **Bikeability**

  Perceived comfort and safety of network connectivity for accessing important destinations

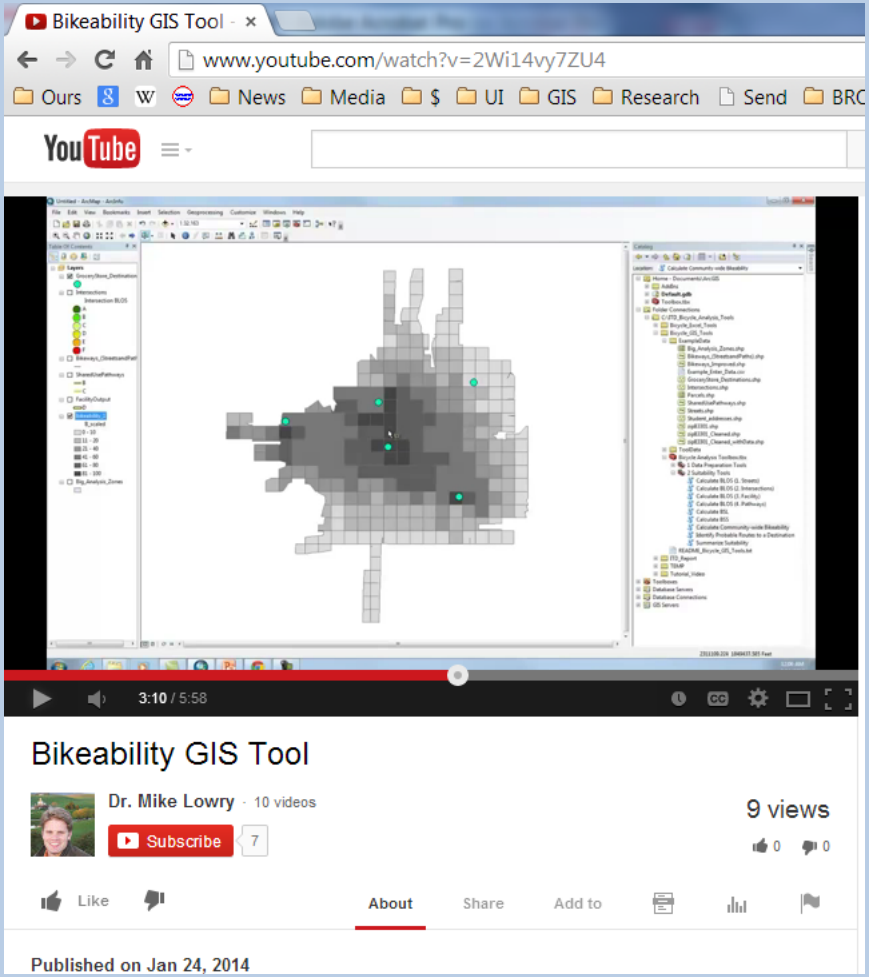
- **Bicycle Friendliness**

  Perceived comfort and safety of all aspects of bicycle travel, including bikeability, laws and policies to promote bicycling, education efforts to encourage bicycling, and general acceptance of bicycling throughout the community


Bikeability
0.00 - 0.05
0.06 - 0.10
0.11 - 0.15
0.16 - 0.20
0.21 - 0.25
0.26 - 0.30
Destination
Existing bik
Proposed bi

[Bikeability Demonstration video]

http://www.youtube.com/watch?v=2Wi14vy7ZU4



Bike Trails, Walking

https://www.traillink.com

Ours | News | Media | $ | UI | GIS | Research | Send | BROOKE | Scholar | PBS | Other bookmarks

TrailLink
by Rails-to-Trails Conservancy

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City, State, Zip:

Trail Name, Keyword:

SEARCH

Powered by: rails-to-trails conservancy

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Download on the App Store

RTC MAGAZINE

***Rails to Trails* Magazine**

Check out the latest issue of *Rails to Trails*, the quarterly magazine of Rails-to-Trails Conservancy, for exciting trail destinations, features and other news.

Check out the magazine

NEW TRAIL REVIEWS

Heritage Rail-Trail
Ohio

Fort Fraser Trail
Florida

Allegheny River Trail
Pennsylvania

replaces bridges at Loop I-610 North and East T.C. Jester. There ...

Three Rivers Heritage Trail System

The Three Rivers Heritage Trail system evolved from five separate trails and today comprises nine

Our Mission

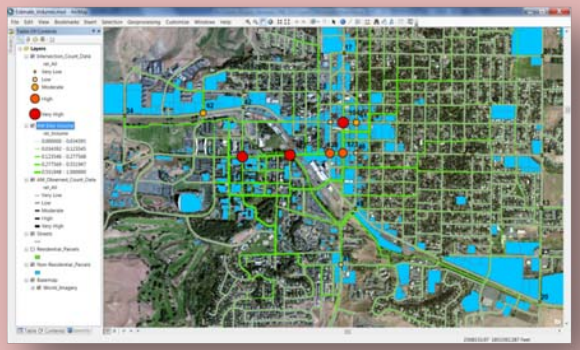
Rails-to-Trails Conservancy is a nonprofit organization based in Washington, D.C., whose mission it is to create a nationwide network of trails

rails-to-trails conservancy

CONCLUSION

Exciting progress…

- Explosion of citizen-volunteer programs…
- Promising new GIS tools…



- Rails-to-Trails is working on connectivity!

TrailLink
by Rails-to-Trails Conservancy


Thank you…
…Questions??
Mike Lowry, PhD, PE
University of Idaho
(208) 885-0139
mlowry@uidaho.edu