Everything You Wanted to Know About Bicyclist and Pedestrian Count Data

Module 3: USING THE DATA

Online Training Presented by:

TxDOT Bicycle and Pedestrian Program &

Texas A&M Transportation Institute (TTI)

August 4, 2020

WELCOME to Module #3: Using Pedestrian and Bicyclist Count Data

- Moderator: Phil Lasley, TTI
- TxDOT Program: Bonnie Sherman, TxDOT
- MODULE 3, USING THE DATA
  - Introduction & Overview
  - Before & After Study
  - Trend Monitoring
  - Safety Analysis
  - Demand Estimation
  - Operation, Maintenance, and TSM
  - OD Patterns
  - Planning & Project Selection
  - Other Uses

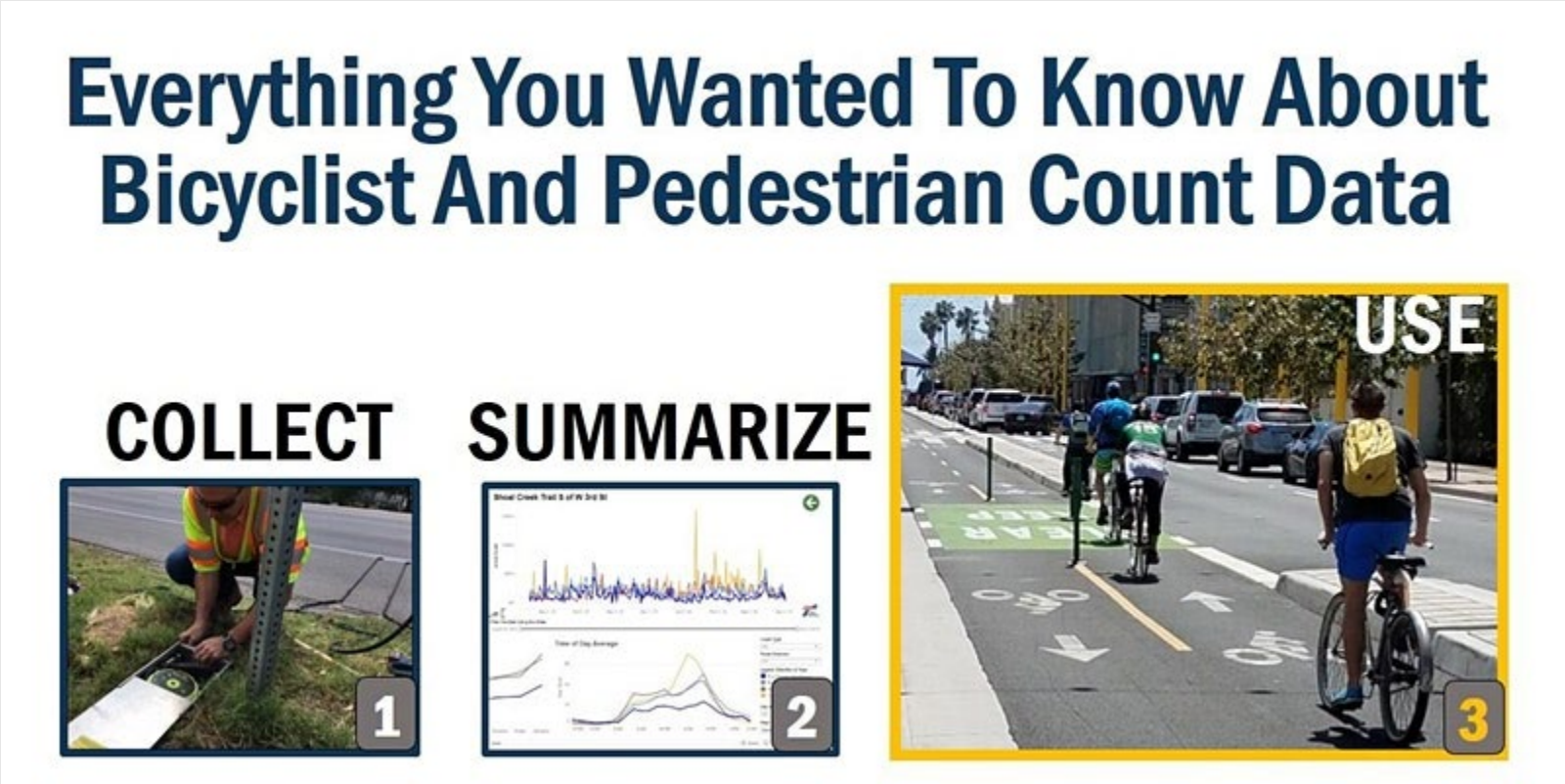
Phil Lasley

Bonnie Sherman

Shawn Turner

Robert Benz

Ipek N. Sener



July 23
Recording

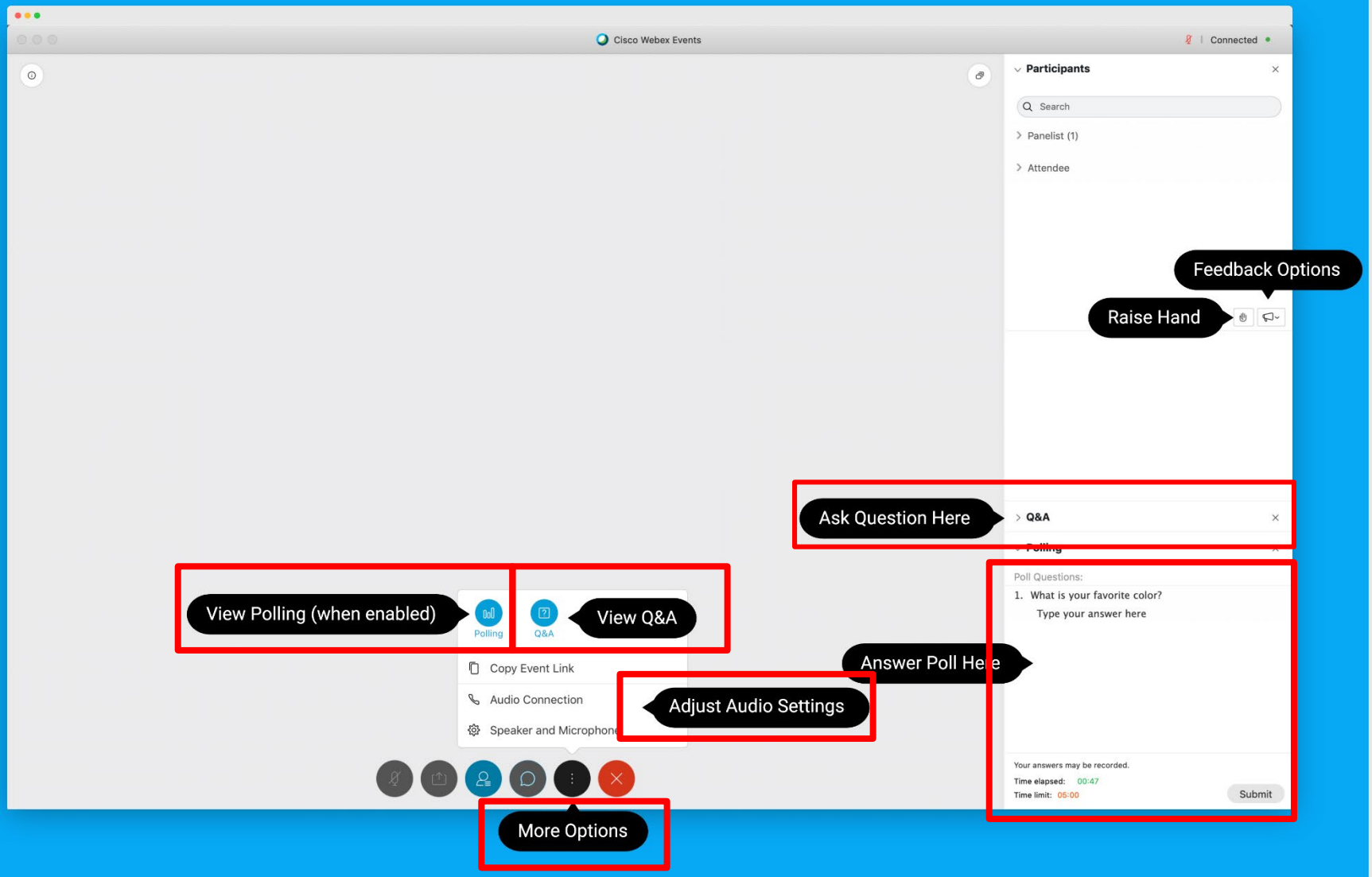
July 29
Recording

TODAY

Best Practices for Virtual Meetings

- Please stay muted unless you are speaking
- Remove all other distractions (work email, instant messenger, etc.)
- Actively participate in training
  - Take notes on slide handouts
  - Use Q&A panel for questions or comments (not chat)
  - Respond to polls
- Webcam not necessary
  - Turn off outgoing video to conserve WiFi bandwidth

Webex Event Features



Introduction Poll

- Please respond to poll at this time
- Any questions before we get started?
  - Feel free to test question box now

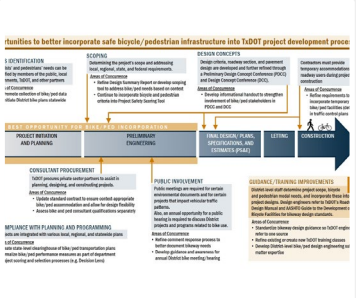
TxDOT Bicycle and Pedestrian Count Program

Bonnie Sherman, TxDOT

Statewide efforts addressing bicycle & pedestrian transportation

Texas Transportation Plan 2050

Bikeway Design Effort



Project Development Enhancements

Road to Zero

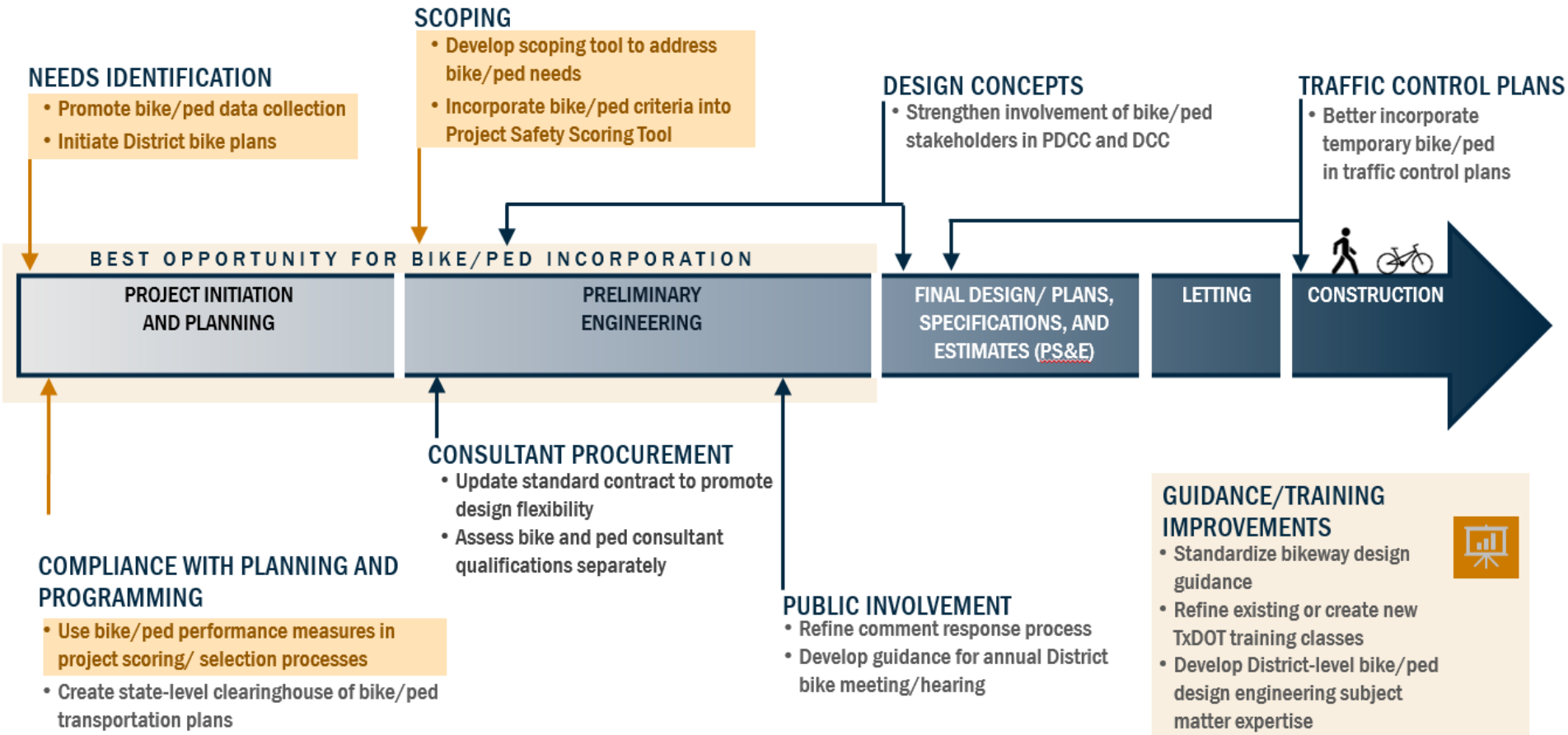
Economic Impact of Bicycling in Texas

ADA Transition Plan Update

Pedestrian/Bicycle Facility Inventory

Bicycle Tourism Trails Study

Better data is needed to better accommodate bicyclists & pedestrians



Better data is needed to better accommodate bicyclists & pedestrians

1	Standardize bikeway design guidance so TxDOT engineers refer to one source
2	Initiate District bicycle plans statewide
3	Continue to incorporate bicycle criteria into Project Safety Scoring Tool
4	Develop District-level bike/ped design engineering subject matter expertise
5	Promote collection of bike/ped data
6	Refine DSR or develop scoping tool to address b/p needs based on context
7	Refine req'ts to better incorporate temporary b/p facilities (detours) in traffic control plans
8	Refine existing or create new TxDOT training classes
9	Refine comment response process to better document bikeway needs
10	Update standard contract to ensure consistent bike/ped accommodation and allow for design flexibility
11	Develop informational handouts to strengthen b/p involvement at PDCC & DCC
12	Create a state-level clearinghouse of bike/ped transportation plans
13	Assess bike and ped consultant qualifications separately
14	Formalize bike/ped performance measures as part of department project scoring and selection processes (e.g. Decision Lens)
15	Develop guidance and awareness for annual District bike meeting/hearing

Better decision-making requires good data

Safety
- Exposure for crash rates
- Behavior (contra-flow riding)

Planning
- Demand estimation
- Travel patterns

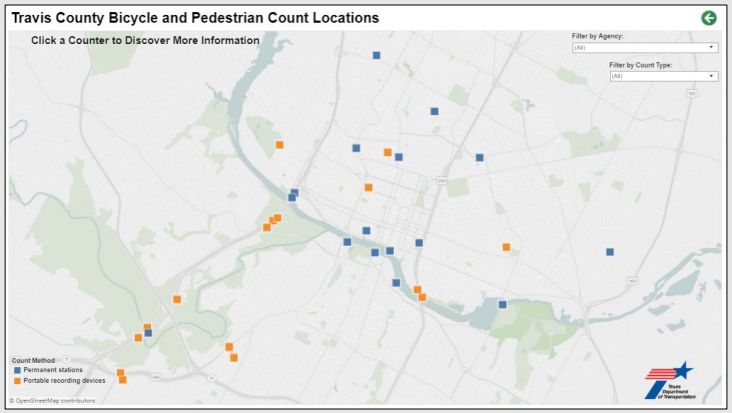
Design
- Facility type and design
- Barriers
- High activity areas

Performance Measurement
- Before and after studies
- Long-term trends from areawide improvements
- Mode shift

We need to know about bicycle and pedestrian usage on our roadways.

Working to resolve the data gap for bicyclists and pedestrians…

- Texas Bicycle and Pedestrian Count Exchange
- Crowdsourced bicycle data (StravaMetro)
- Counter equipment loan program
- Upcoming procurement of bike/ped counts
- Data collection and analysis guidance
- Virtual training in Summer 2020



Thank you!

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https://www.txdot.gov/inside-txdot/modes-of-travel/bicycle.html

Questions?

Using Bicyclist and Pedestrian Count Data

Shawn Turner

Robert Benz

Ipek N. Sener

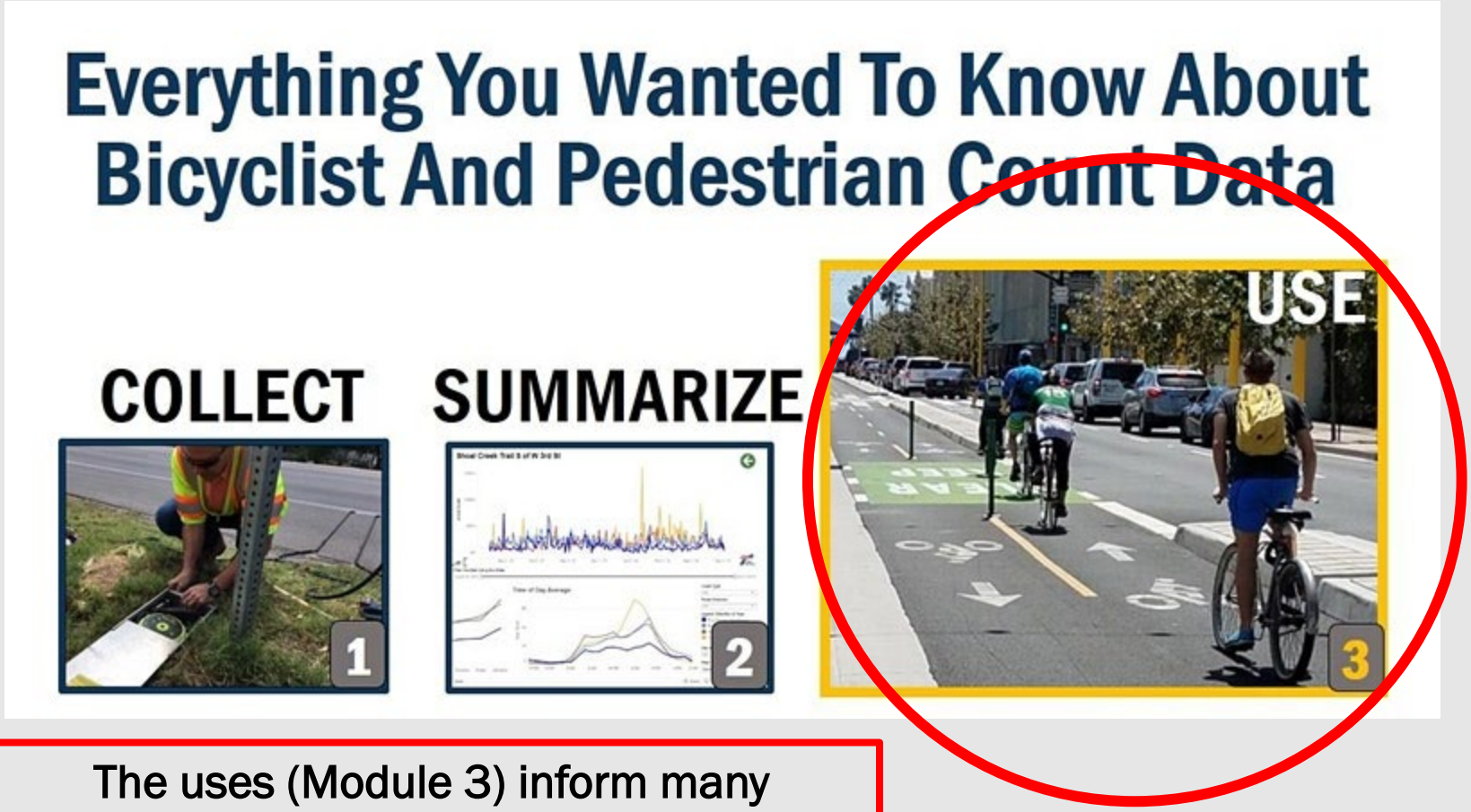
Using pedestrian and bicyclist count data

- Catch-22

- “We shouldn’t collect ped/bike count data until we have a defined business process for using it.”
- “We haven’t used ped/bike count data because it hasn’t been available”

- Currently working to get out of this circular logic

“Plan your destination before you start your trip”



The uses (Module 3) inform many decisions made in these first 2 modules

How will you (and others) use count data?

- Most likely will have multiple uses
- Will have to balance the requirements for multiple uses
- Will be used for more things than what you planned

- Uses we will highlight today:
  - Trend Monitoring
  - Before & After Study
  - Safety Analysis
  - Demand Estimation
  - Operation, Maintenance, and TSM
  - OD Patterns
  - Planning & Project Selection
  - Other Uses

Lots of other uses for pedestrian and bicyclist count data

Primary Pedestrian and Bicycle Traffic Volume Data Elements by Purpose

Purpose	Geographic Level	Primary Data Collection Elements*
Formulate public policy	Area	Travel survey repeated at regular time intervals and permanent continuous counters with additional short duration counts
Measure change over time	Path or road	Permanent continuous counters with additional short duration counts, if needed
	Area	Travel survey repeated at regular time intervals
Prioritize projects	Path or road	**Short duration cyclical counts adjusted with temporal adjustment factors from permanent continuous counters**
Plan and design future facilities	Path or road	
Calibrate regional model	Path or road	
Assess and market commercial real-estate	Path or road	
Identify and assess the value of locations for advertising (billboards, etc.)	Path or road	
Study safety performance	Road	
	Intersection	Turning and crossing movement counts, usually at peak hours; preferably adjusted with temporal adjustment factors from permanent continuous counters
Adjust signal timing	Intersection	Turning movement counts including crosswalks, usually at peak hours
Conduct before/after safety study	Safety counter-measure on road segments or intersection	Special purpose short duration counts, preferably adjusted with temporal adjustment factors from permanent continuous counters
Compare safety performance across cities or regions	Area	Travel survey or diary
Assess community-wide physical activity	Area	

Table 1. Primary Pedestrian and Bicycle Traffic Volume Data Elements by Purpose

Note: "Area" indicates neighborhood, city, or any other population level area beyond a single facility.

* This does not include the many data sources that could supplement these data sources (such as GPS trace data from smartphone apps, or sociodemographic data from the American Community Survey), nor does it include other types of data that would be needed for these purposes such as infrastructure, crash data, or sociodemographic information.

Source: http://www.pedbikeinfo.org/cms/downloads/PBIC_Infobrief_Counting.pdf

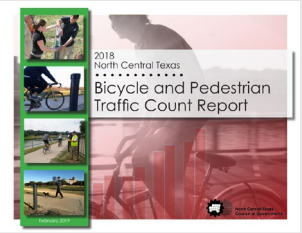
Trend monitoring

- "How has biking/walking changed since last year/month/week?"
  - Citywide/areawide
  - Subareas or neighborhoods
  - Corridors or locations

- Situational awareness that informs various decisions, esp. policy changes

- For example:
  - More emphasis on facility designs that attract the most users
  - Better/more frequent maintenance (e.g., street sweeping)
  - Private/commercial investment in redeveloping areas

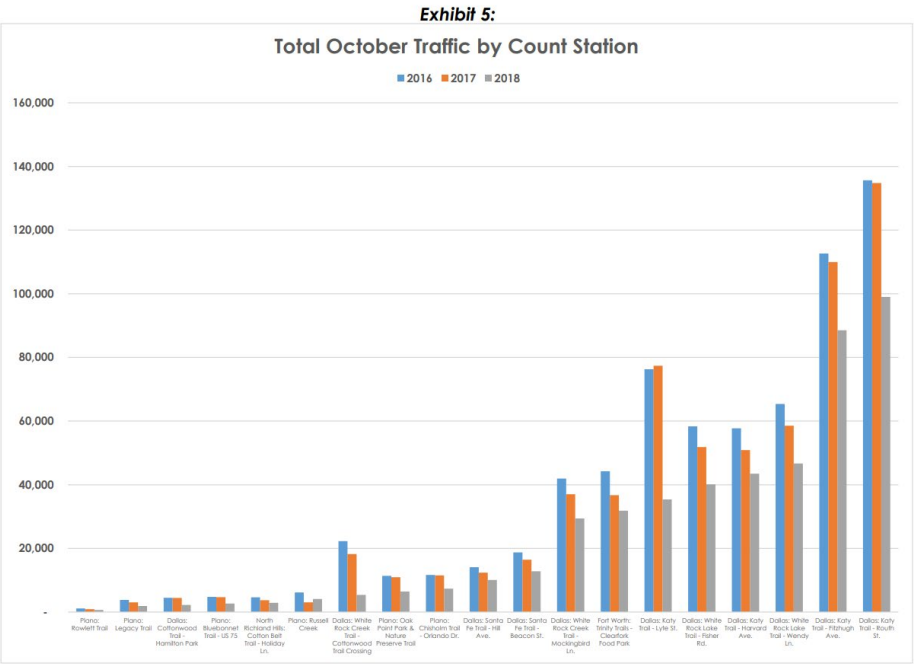
Trend monitoring



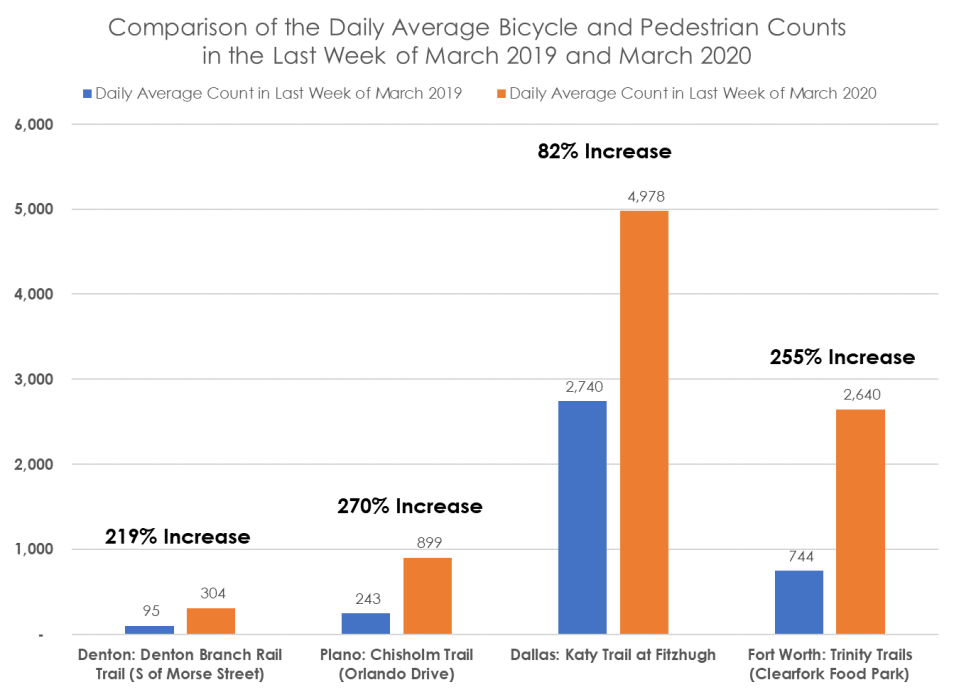
North Central Texas Council of Governments (NCTCOG)

- Annual benchmarking report

Year-to-year Trends

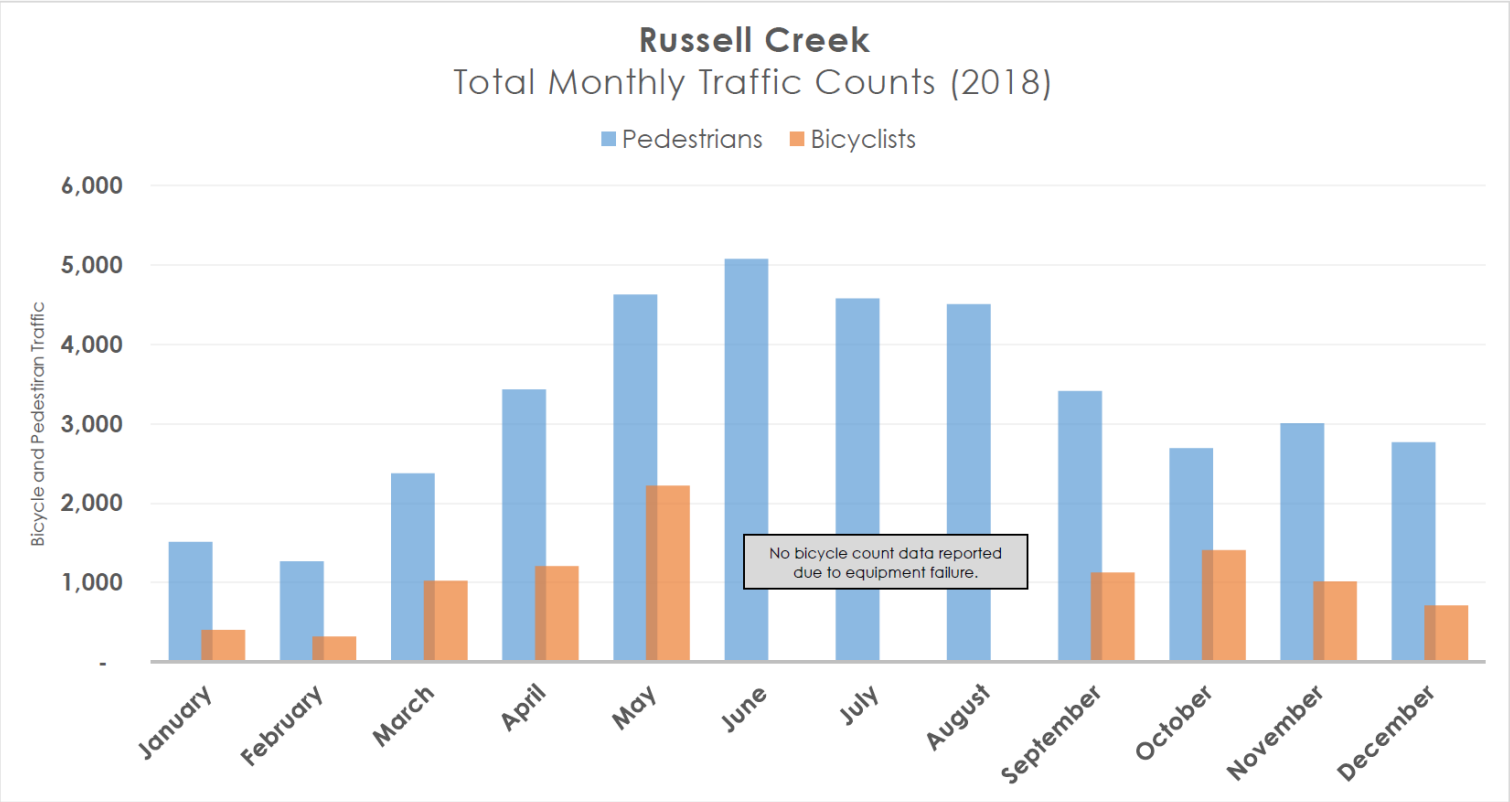


Special Event Analysis



https://www.nctcog.org/trans/quality/bikeped/regional-bicycle-and-pedestrian-traffic-monitoring

Count Station Summary



2018 Annual Traffic (partial year)	
Pedestrians	39,266
Bicyclists	9,419
Total Traffic	**48,685**

Source: https://www.nctcog.org/nctcg/media/Transportation/DocsMaps/Plan/Bike/NCTCOGBikePedTrafficReport_2018.pdf

Trend monitoring: Key considerations

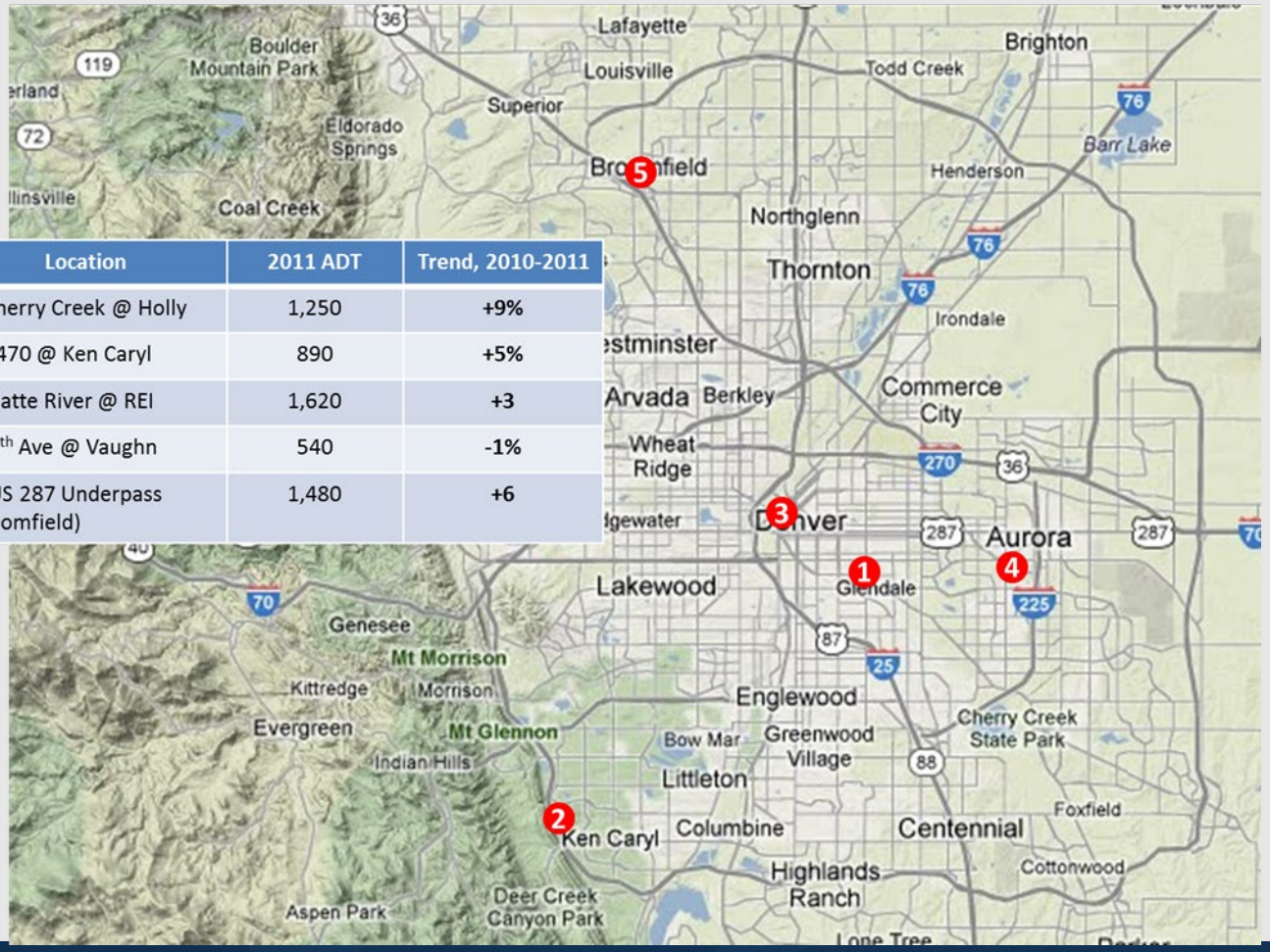
- REPRESENTATIVE locations
  - NOT JUST BUSIEST LOCATIONS!
  - What areas/locations are you trying to represent in your trends?

- Don’t over-extend the application of your trends
  - For example, 3 counters on a single facility type and then saying “Biking is up XX% citywide”
  - Build credibility with transparency, not hyperbole

Trend monitoring: Key considerations

- Hypothetical example – limited count locations

Biking and Walking in Denver



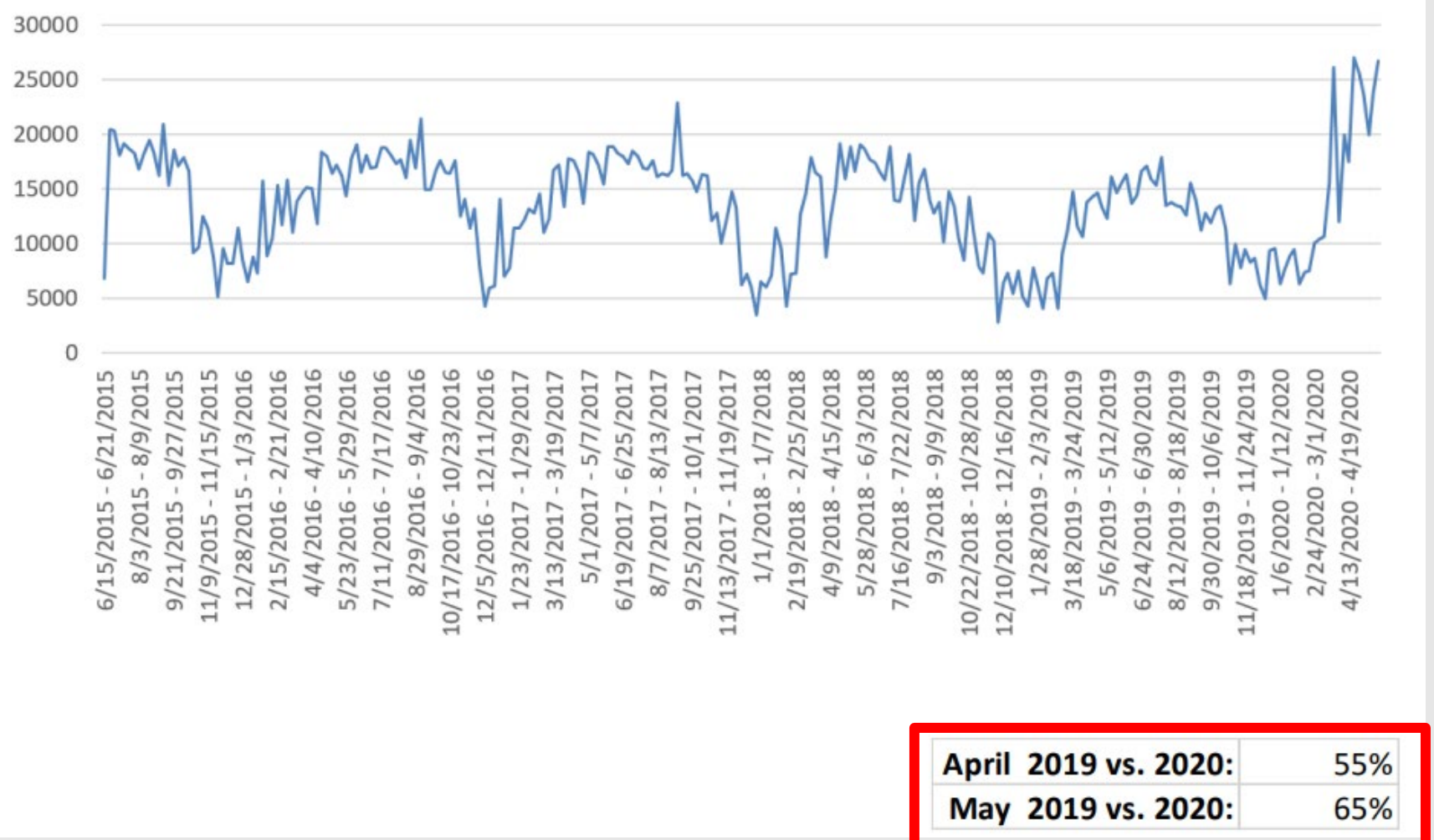
Location	2011 ADT	Trend, 2010-2011
1. Cherry Creek @ Holly	1,250	+9%
2. C470 @ Ken Caryl	890	+5%
3. Platte River @ REI	1,620	+3
4. 6th Ave @ Vaughn	540	-1%
5. US 287 Underpass (Broomfield)	1,480	+6

Trend monitoring: Key considerations

- Make it super-easy to QUANTIFY THE TREND
  - Create visuals for non-technical people
  - Don’t make them guess or extrapolate % values
  - Write out your main takeaway point(s) on the chart

Trend monitoring: Key considerations

- Make it super-easy to QUANTIFY THE TREND



April 2019 vs. 2020:	55%
May 2019 vs. 2020:	65%

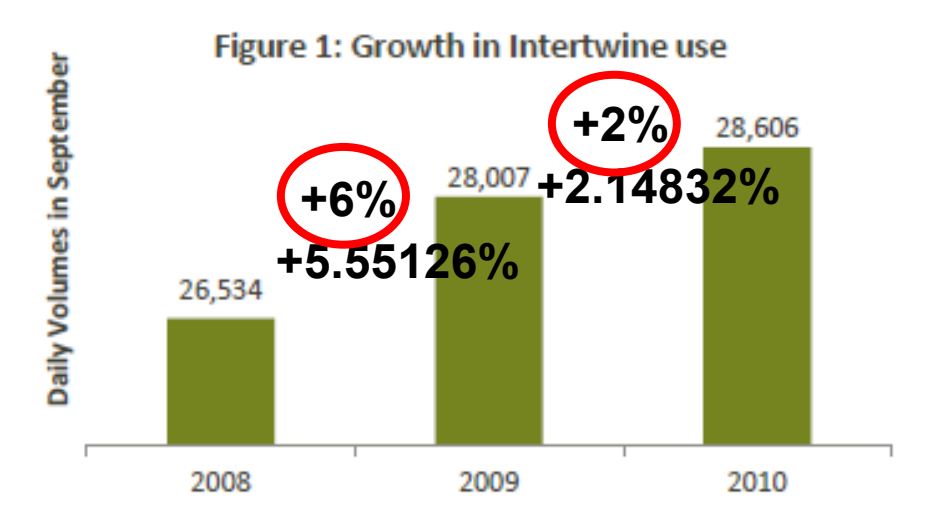
Trend monitoring: Key considerations

- Make it super-easy to QUANTIFY THE TREND

Figure 1: Adjusted annual trails count

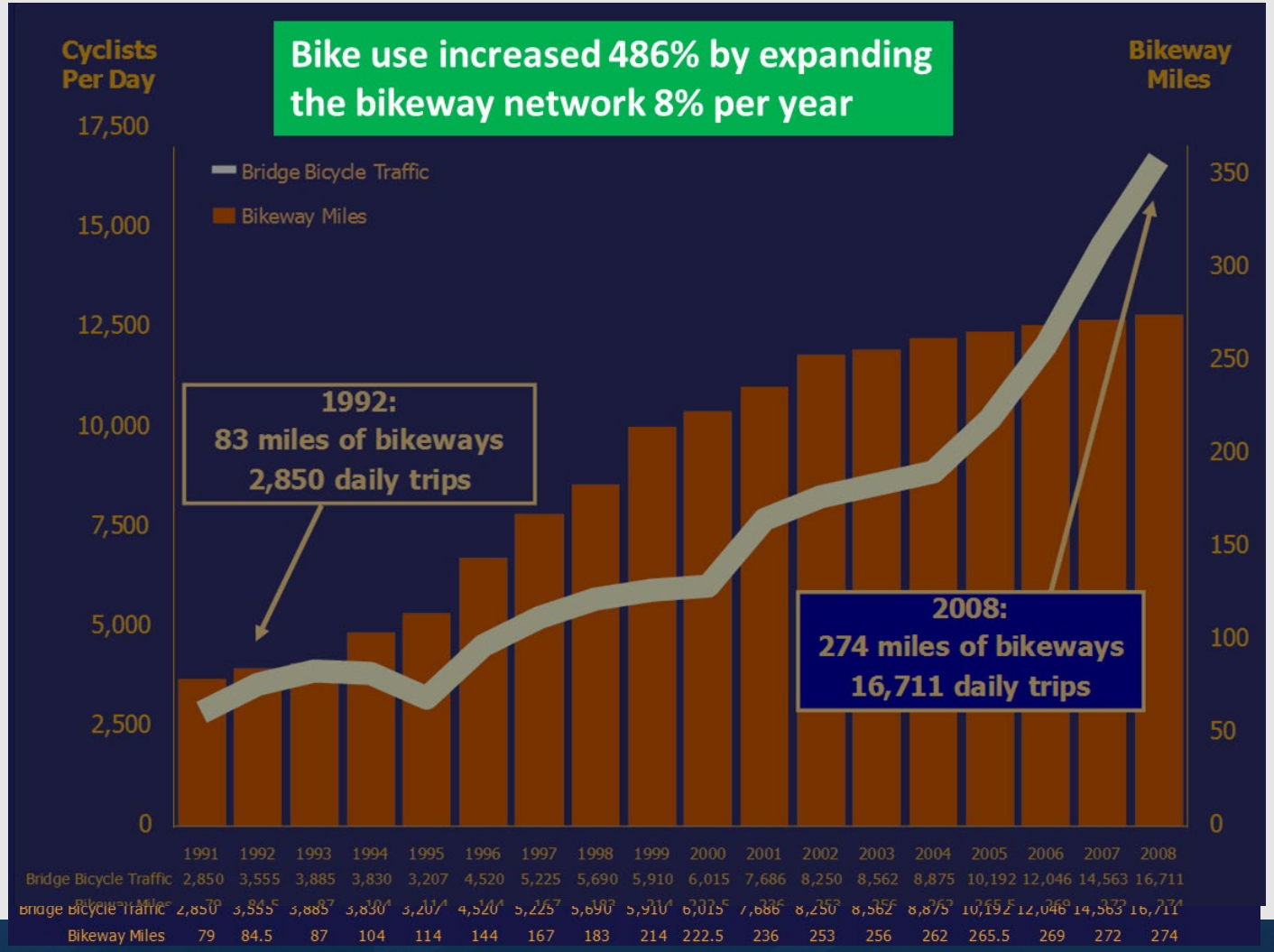
Trail/Pathway	Estimated Monthly visits/trips*	Estimated Annual visits/trips*
Burnt Bridge Creek Trail	20,316.00	**253,955.00**
Columbia River Renaissance Trail	78,932.00	**986,645.00**
Frenchman's Bar/Vancouver Lake Trail	11,046.00	**138,073.00**
I205 Pathway	10,472.00	**130,901.00**
I5 Pathway	7,056.00	**88,197.00**
Lacamas Heritage Trail	19,935.00	**249,192.00**
Padden Parkway Pathway	8,290.00	**103,622.00**
Salmon Creek Trail	48,955.00	**611,937.00**

*Data adjusted per National Bicycle & Pedestrian Documentation Project Count Adjustment Factors March 2009



Trend monitoring: Key considerations

- Make it super-easy to QUANTIFY THE TREND

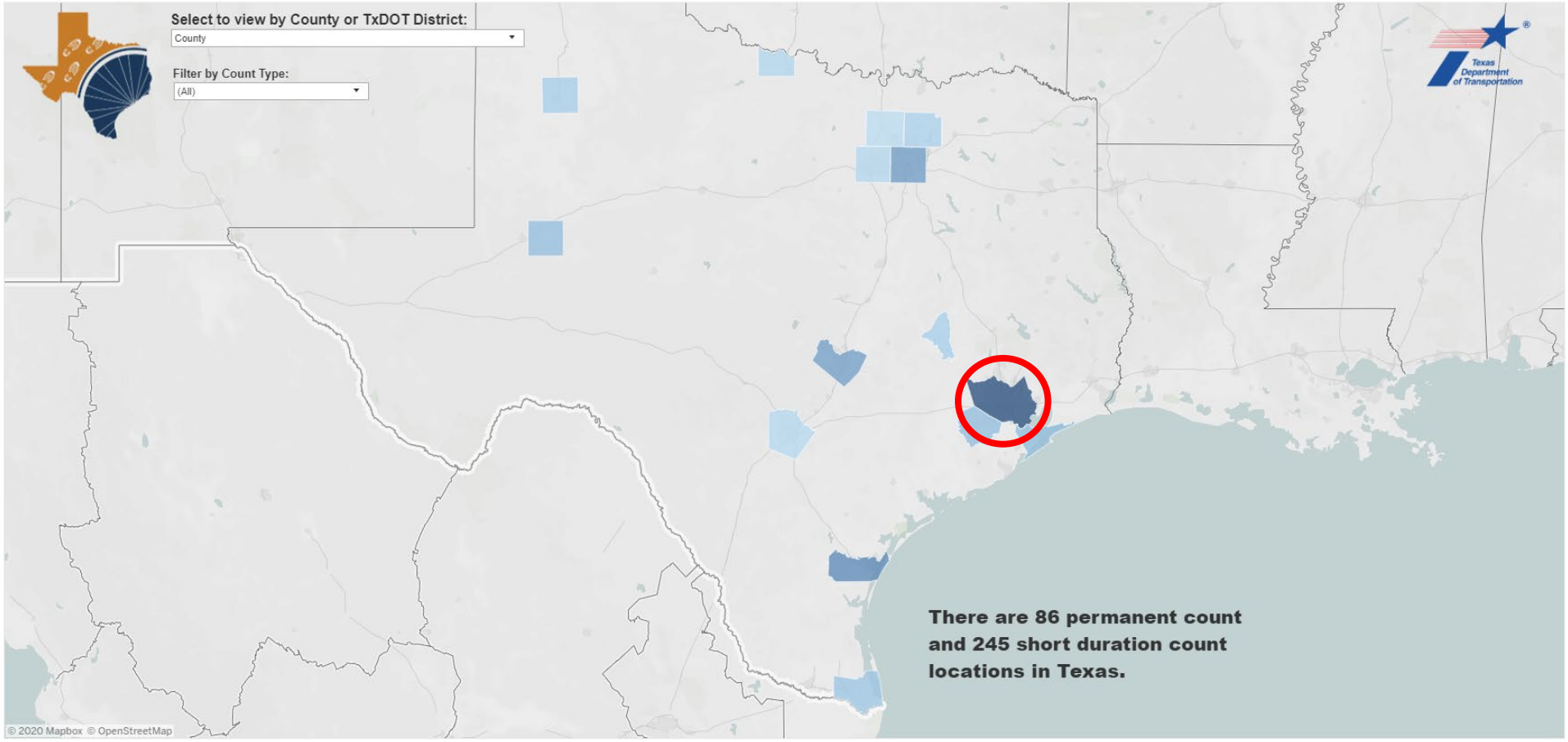


	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Bridge Bicycle Traffic	2,850	3,555	3,885	3,830	3,207	4,520	5,225	5,690	5,910	6,015	7,686	8,250	8,562	8,875	10,192	12,046	14,563	16,711
Bikeway Miles	79	84.5	87	104	114	144	167	183	214	222.5	236	253	256	262	265.5	269	272	274

Source: Roger Geller, City of Portland

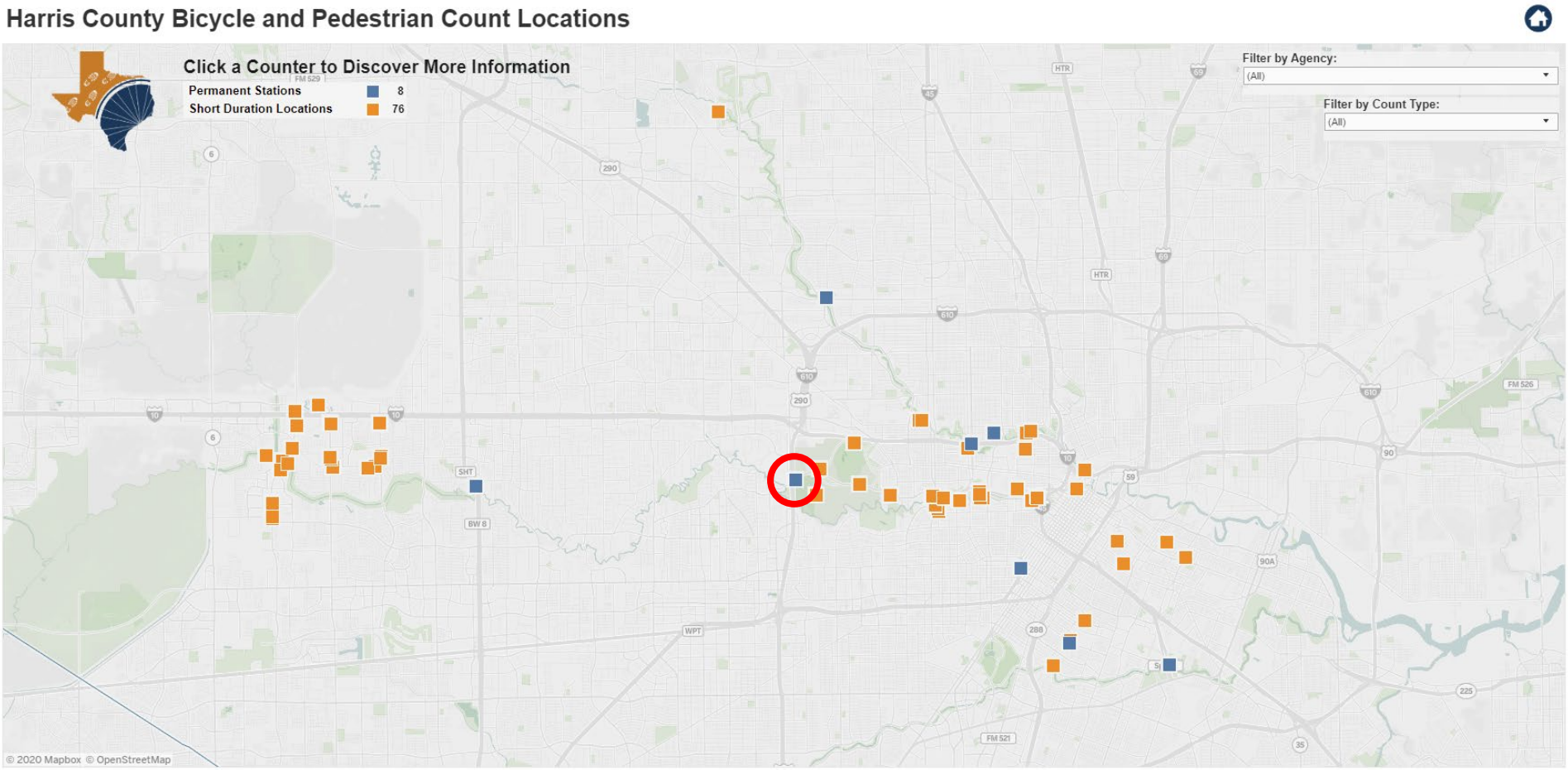
Trend monitoring: Key considerations

- Start big-picture, provide drill-down options



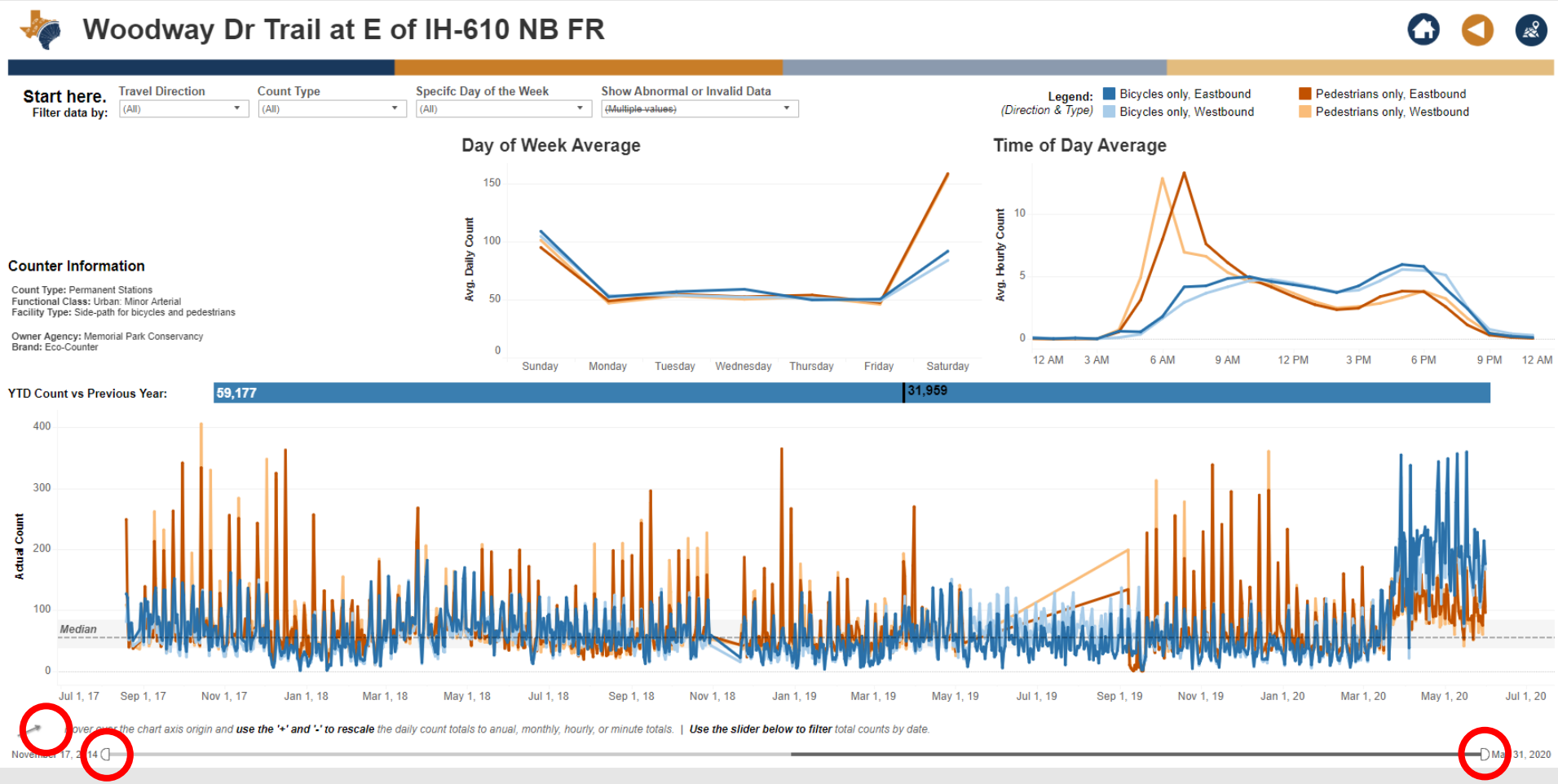
Trend monitoring: Key considerations

- Start big-picture, provide drill-down options



Trend monitoring: Key considerations

- Start big-picture, provide drill-down options



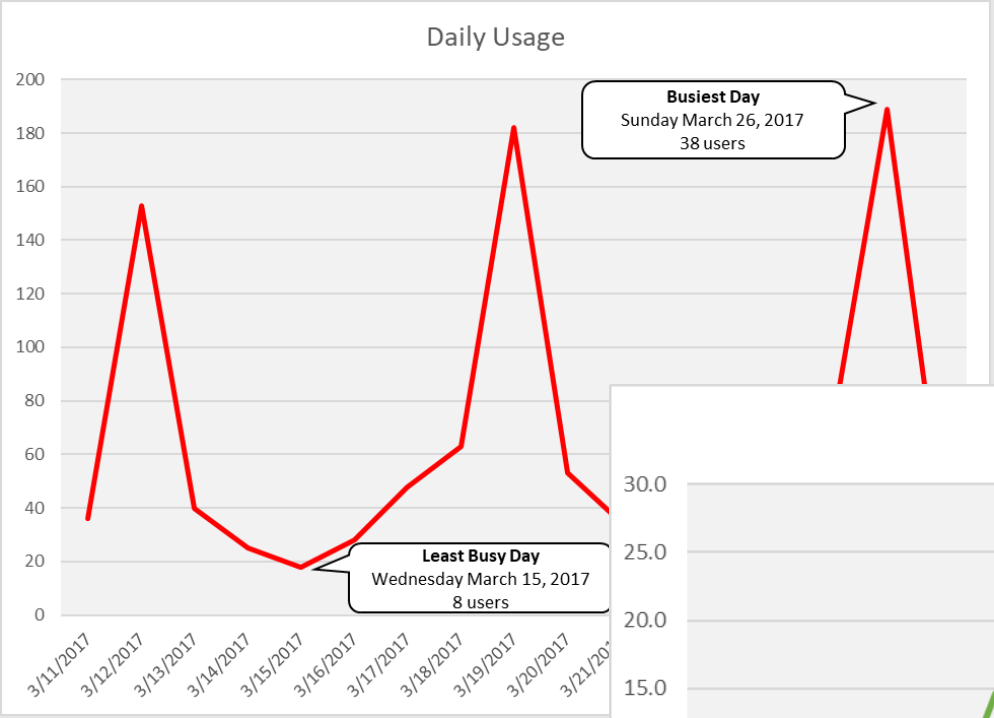
Trend monitoring: Key considerations

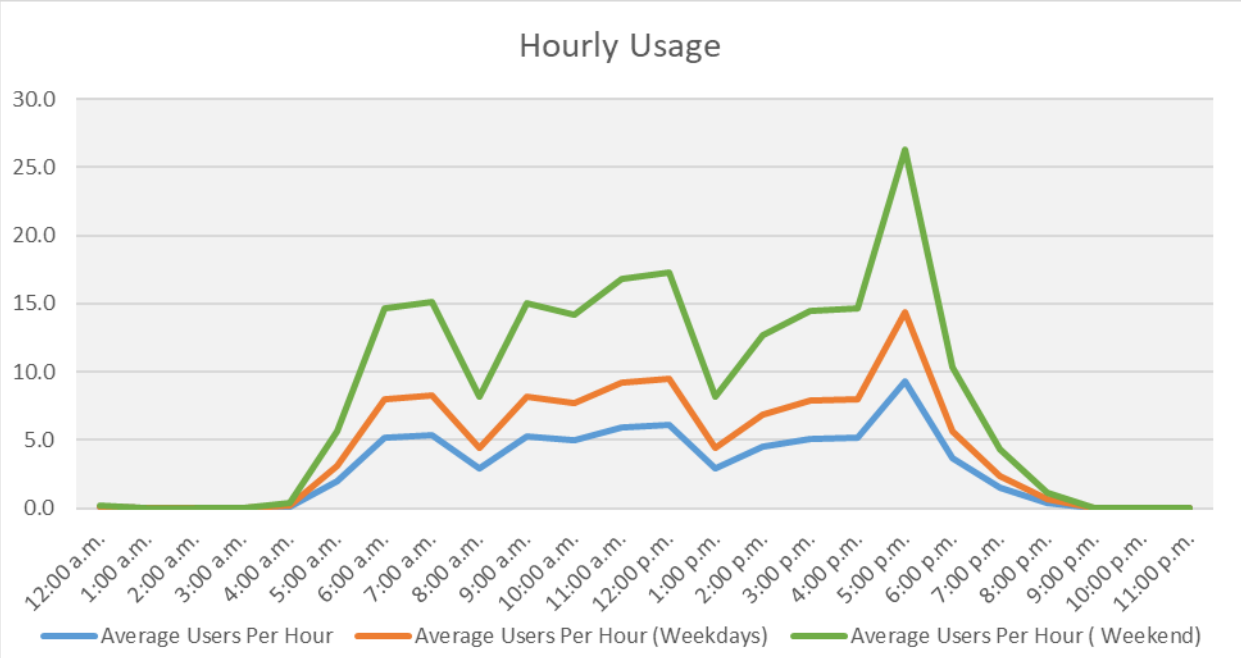
- Start big-picture…

H2 malfunctioned and did not count.

Trend monitoring: Key considerations

- … then provide drill-down options

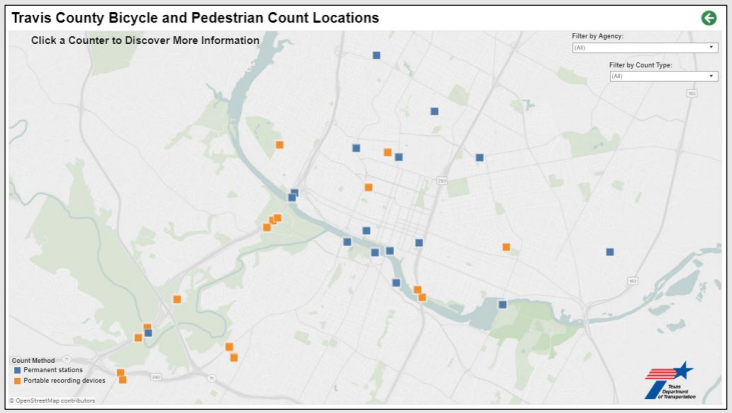




Trend monitoring: how to get started?

What's needed to start?

- Select count representative locations in 3 pattern groups
  - Commuting to work/school routes
  - Recreational/utilitarian routes
  - Hybrid/mix of commuting and recreation
- FHWA TMG recommends 3-5 permanent locations in each group
- Test locations with short-term counts
- Install permanent counters (phased approach)
- ~3 years of clean, complete data
- Equipment maintenance program



Before & after study

- "I changed **X** at this(these) location(s), do more people bike/walk now?
  - X = facilities (i.e, sidewalks, bikeways)
  - X = bikeshare program
  - X = land use/development

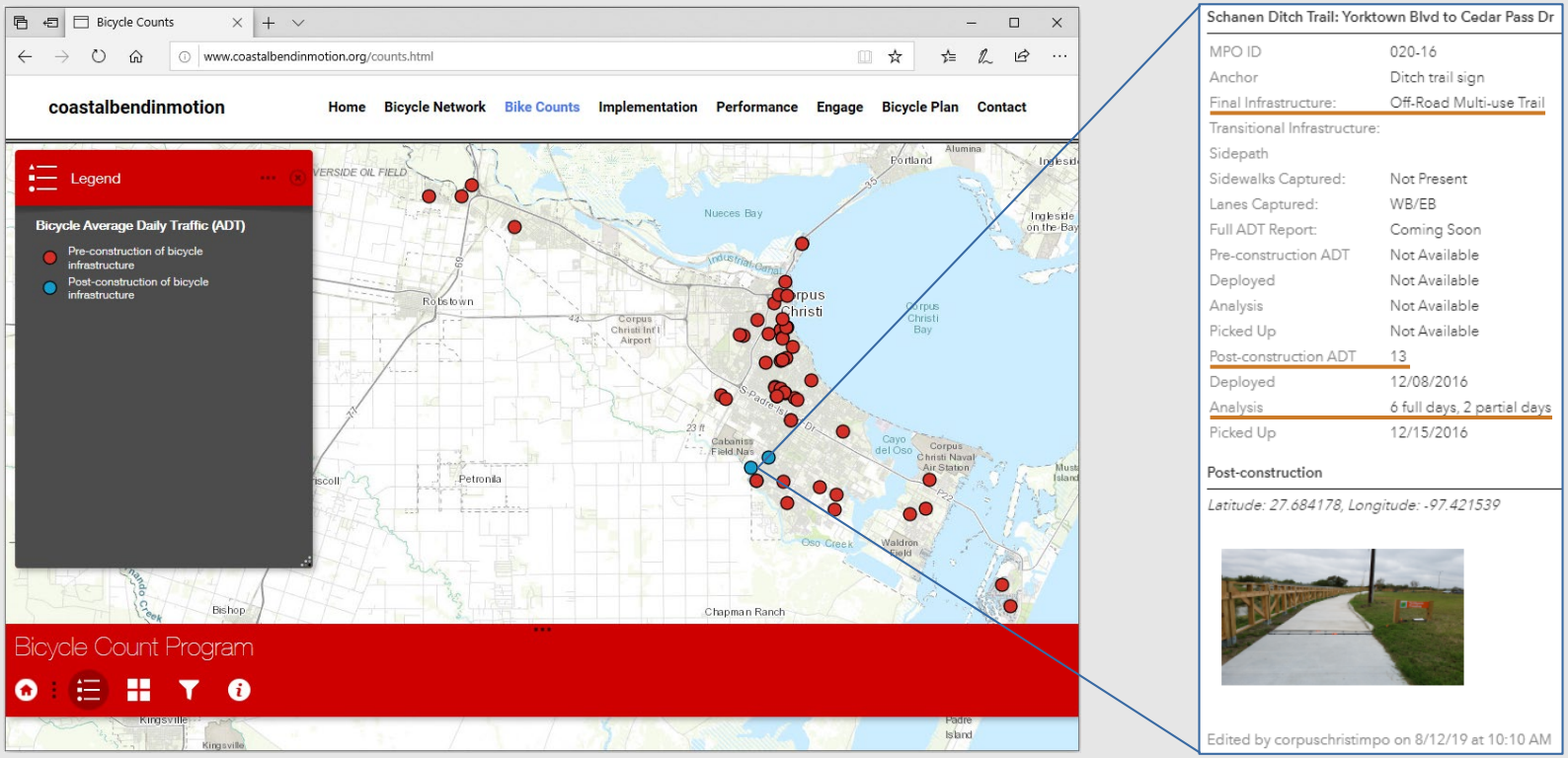
- Heard of 3E? It's actually 5E!
  - **Evaluation**, Engineering, Education, Enforcement, Encouragement

- Reinforces existing policies or informs policy changes
  - Facility design
  - Zoning/mixed land use
  - Effectiveness of traffic control devices
  - Etc.

Before/after study

Corpus Christi MPO

- Before and after-construction bike counts for projects around the area
- Data collection separates anecdotal information from the facts



http://www.coastalbendinmotion.org/counts.html

Cameron County

Before & after study: Key considerations

- BIGGEST CHALLENGE: ?

Before & after study: Key considerations

- Comparing conditions before and after a change:
  - No other changes in vicinity
  - Same time of year (or adjust seasonality)
  - Random variation
  - Regression to the mean ("nowhere to go but up")

- Comparison/control sites
- Minimizing other possible changes
- Empirical Bayes (statistical approach)
- Getting researchers involved

Methodology	Ability to determine or account for:			
	Treatment Effect	Exposure Effect	Trend Effect	Random Effect
Before-and-After with Empirical Bayes	Yes	Yes	Yes	Yes
Before-and-After with Comparison Group	Yes	Yes	Yes	No
Before-and-After with Yoked Comparison	Yes	Yes	Potential	No
Naïve Before-and-After Study	Yes	Potential	No	No

Before & After Studies

What's needed to get started?

- Portable equipment
- Determine locations
  - Planned improvements
  - Moderate to high activity levels (also growth potential)
  - Not just the highest-volume locations
- Count before & after (7-14 days) during an average time of year
- Upload and verify count data in the BP|CX platform
- Repeat as the area changes

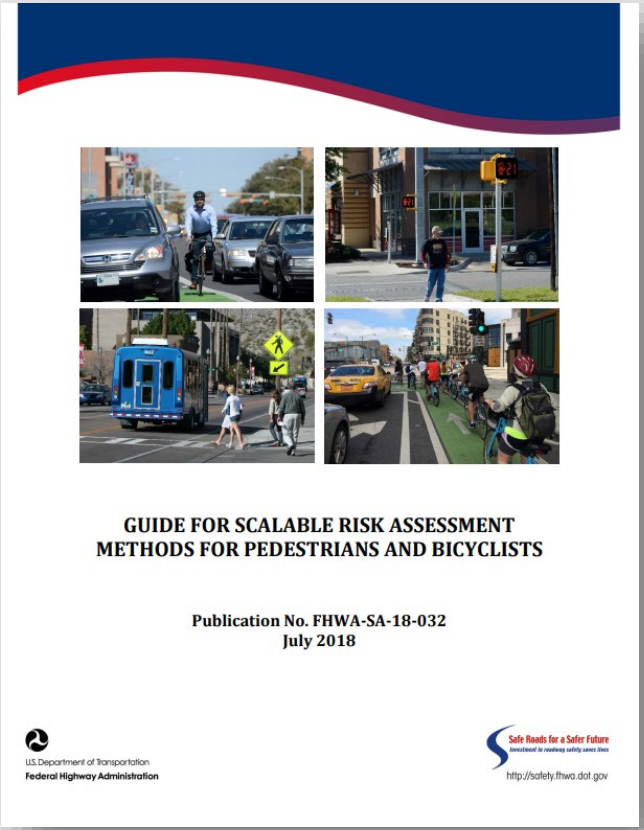
TxDOT Loan Program

Safety analysis

- Next 2 uses come from FHWA Scalable Risk Assessment Methods for Pedestrians and Bicyclists, Report FHWA-SA-18-032 (https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa18032/)

Different types of safety analysis

A. Safety performance measures
B. Network screening, area-based
C. Network screening, facility-based
D. Project prioritization
E. Countermeasure evaluation
F. Site evaluation


GUIDE FOR SCALABLE RISK ASSESSMENT METHODS FOR PEDESTRIANS AND BICYCLISTS

Publication No. FHWA-SA-18-032
July 2018

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
http://safety.fhwa.dot.gov

What is common element in safety analyses?

1 cyclist

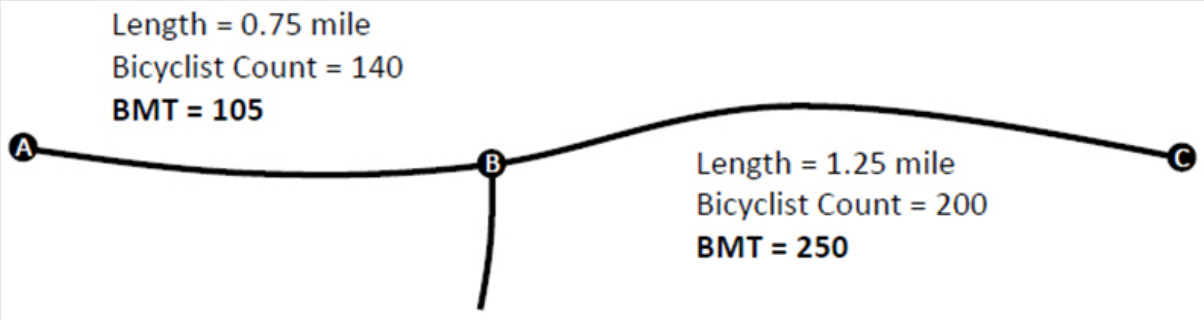
20 cyclists

EXPOSURE!

Crash rate definition

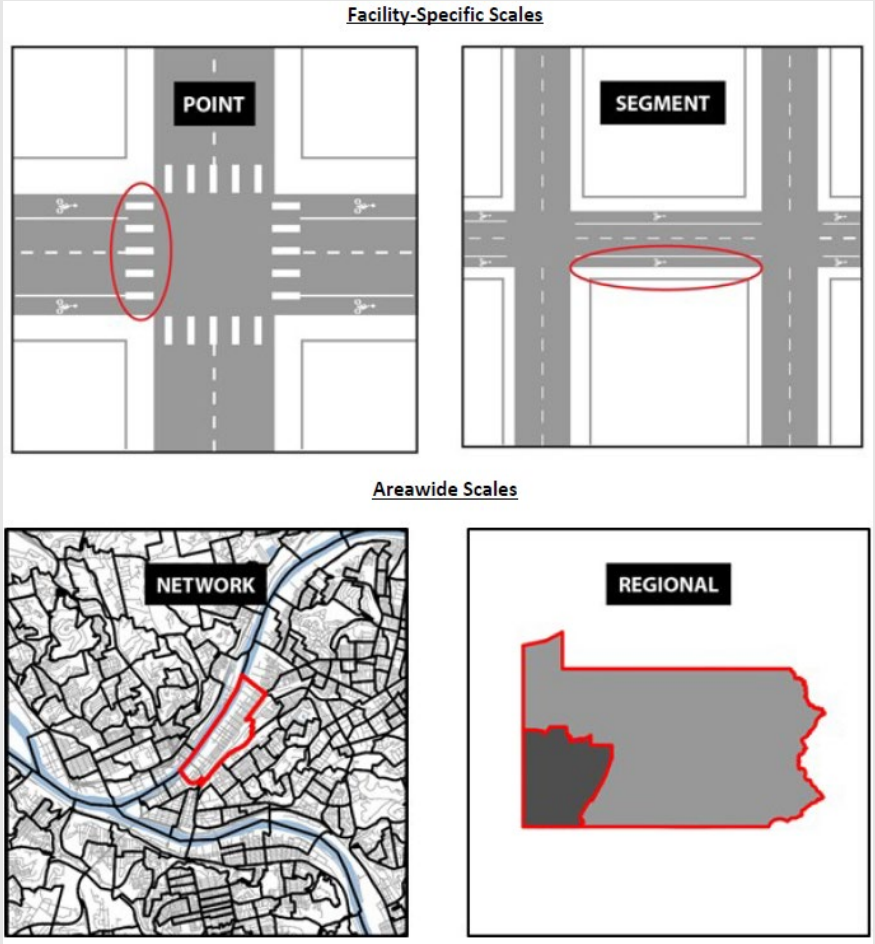
$$\text{Crash Rate} = \frac{\text{Observed crashes}}{\text{Exposure}}$$

$$\text{Crash Rate} = \frac{\text{Observed crashes}}{\text{Counts x distance traveled}}$$



Exposure in Safety Analysis

- Exposure Estimation Options:
  - Counts
  - Demand Estimation Models
    - Several options here
  - Travel Surveys
    - ACS
    - NHTS
    - Regional household travel survey

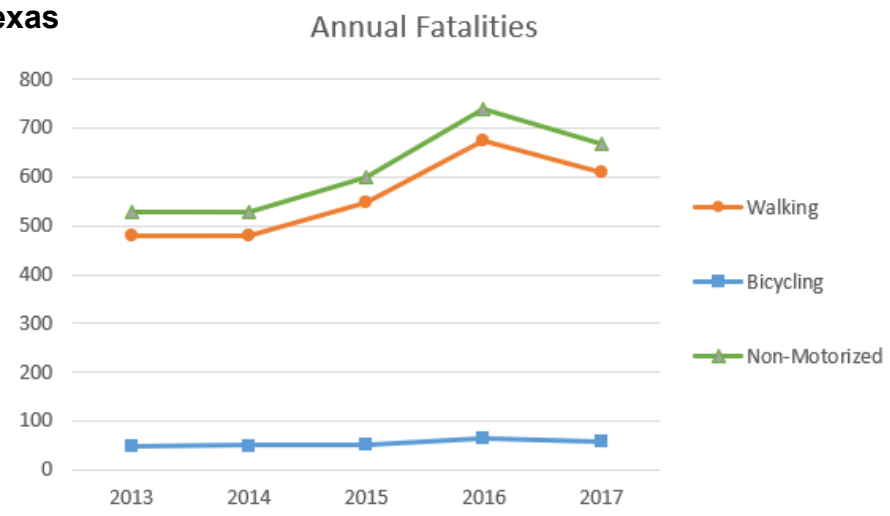


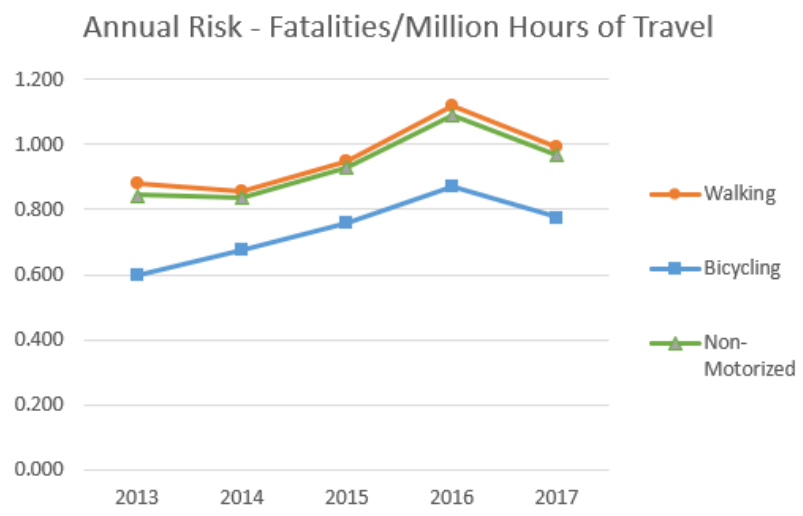
Source: Guide for Scalable Risk Assessment Methods for Pedestrians and Bicyclists (FHWA)

Exposure in Safety Analysis

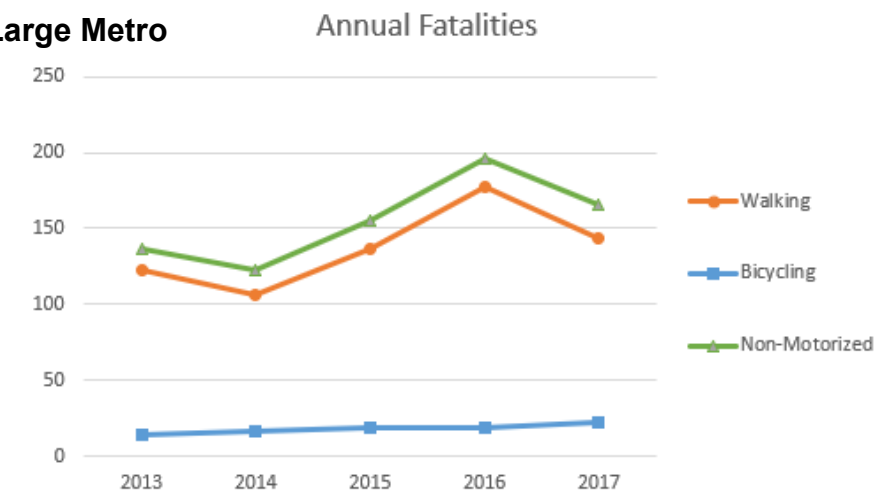
- Risk = Crashes / Exposure
  - Larger geographic areas – more likely to use surveys than counts

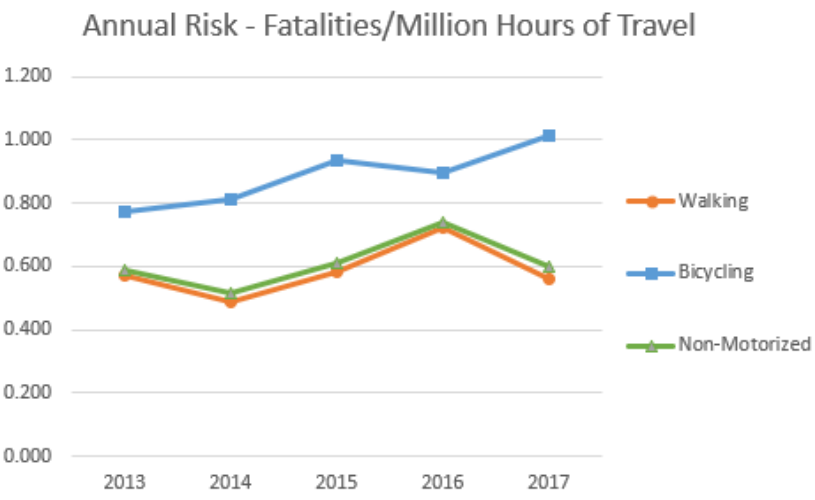
Texas





Large Metro





Exposure in Safety Analysis

- **What's needed to get started?**
  - Guide for Scalable Risk Assessment Methods for Pedestrians and Bicyclists (FHWA)
  - Facility-specific counts
    - Use automated counter equipment as much as possible
    - Avoid very short duration counts (i.e., two-hour counts)
    - Seek balance between number of count locations and duration
    - Select representative months and days of week for your area and count location
    - Focus on balance of high-priority yet representative locations

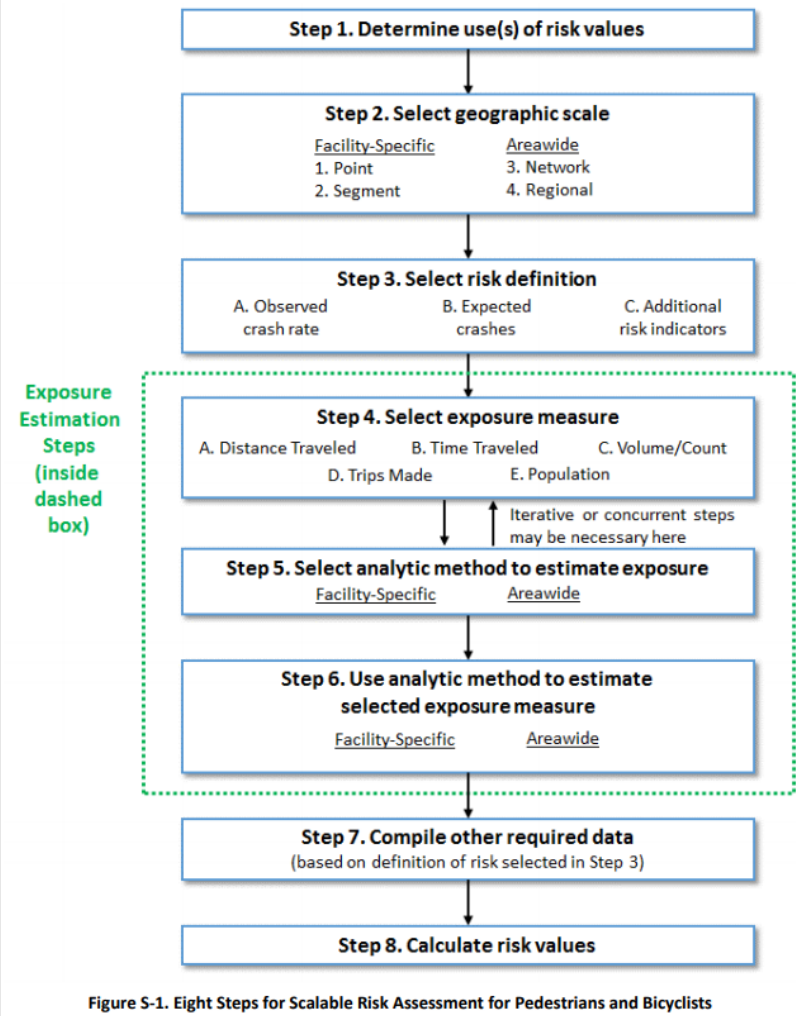


Figure S-1. Eight Steps for Scalable Risk Assessment for Pedestrians and Bicyclists

Source: Guide for Scalable Risk Assessment Methods for Pedestrians and Bicyclists (FHWA)

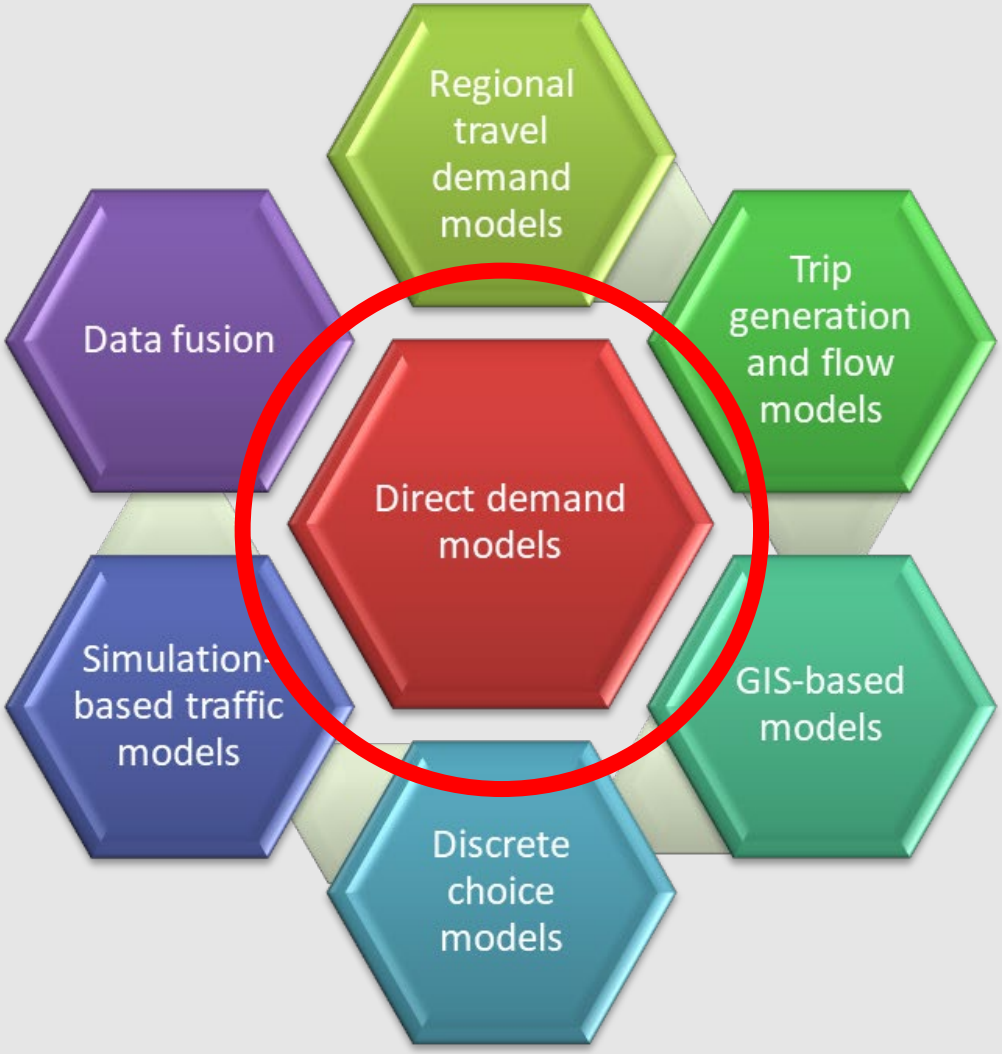
Using Bicyclist and Pedestrian Count Data

Demand Estimation

Ipek N. Sener

Demand Estimation Models

- Numerous models to estimate pedestrian and bicyclist demand.
- The models range in complexity and input requirements.
- Most require COUNT DATA to develop and calibrate.

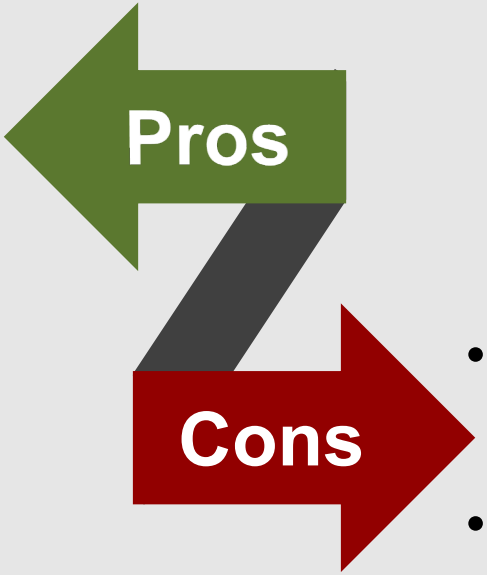


Direct Demand Models

- Statistical models
  - often based on regression analysis
  - developed using different data sources
- Primarily used to develop facility-specific demand estimations
  - facility use or needs
  - estimates of non-motorized activity
  - connection between the built environment and non-motorized demand

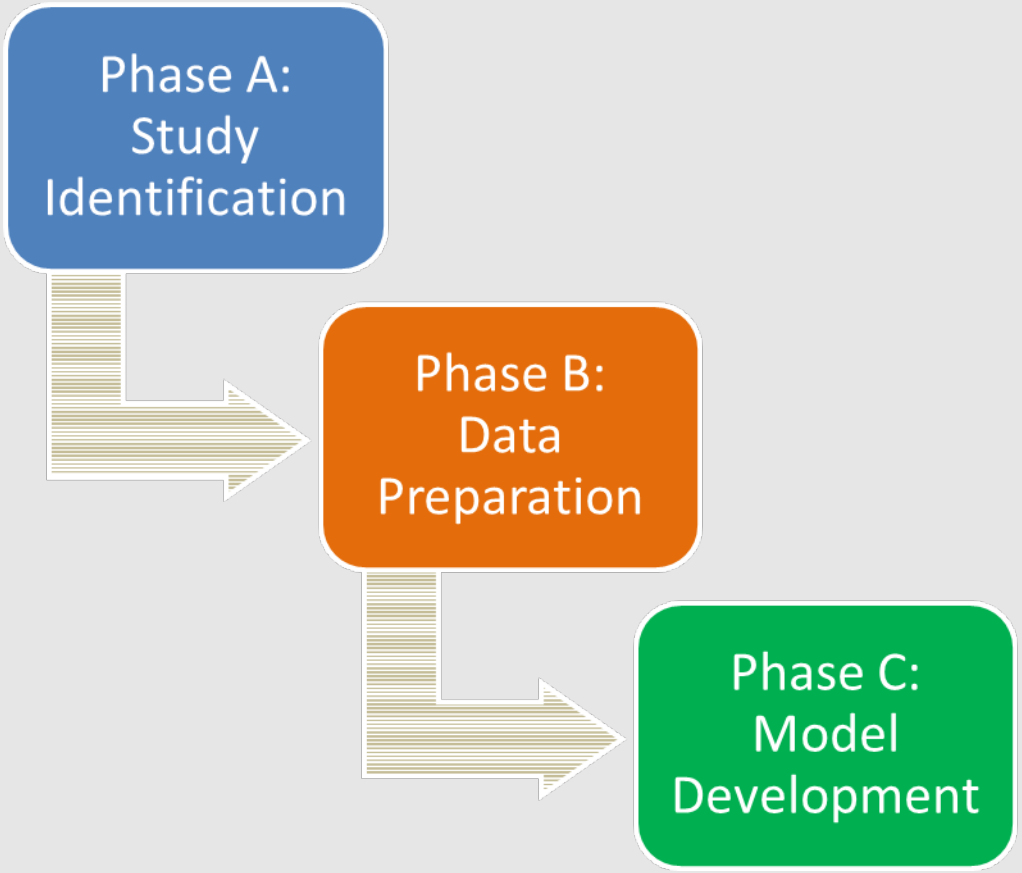
Direct Demand Models

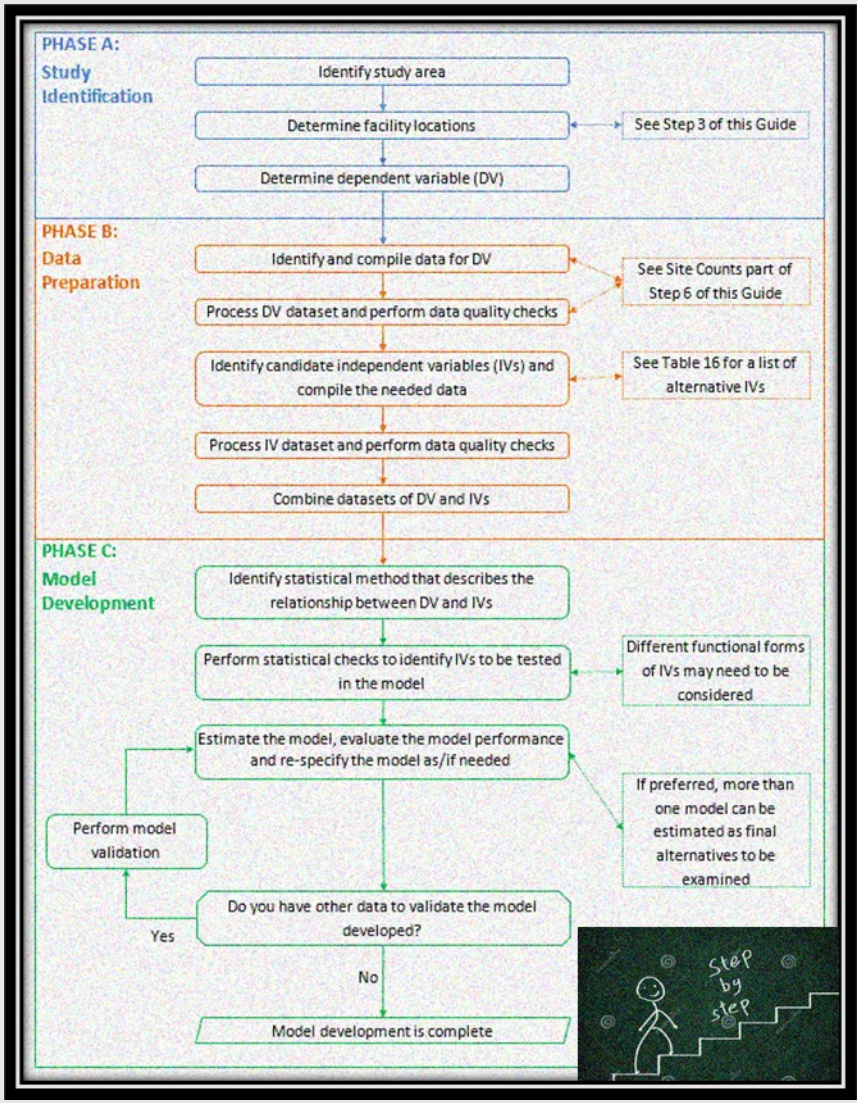
- Simple, practical and generally based on available data
- Particularly useful for screening and preliminary analyses when resources are limited



- Usually not transferable
- Limited in terms of capturing the underlying behaviors and travel patterns

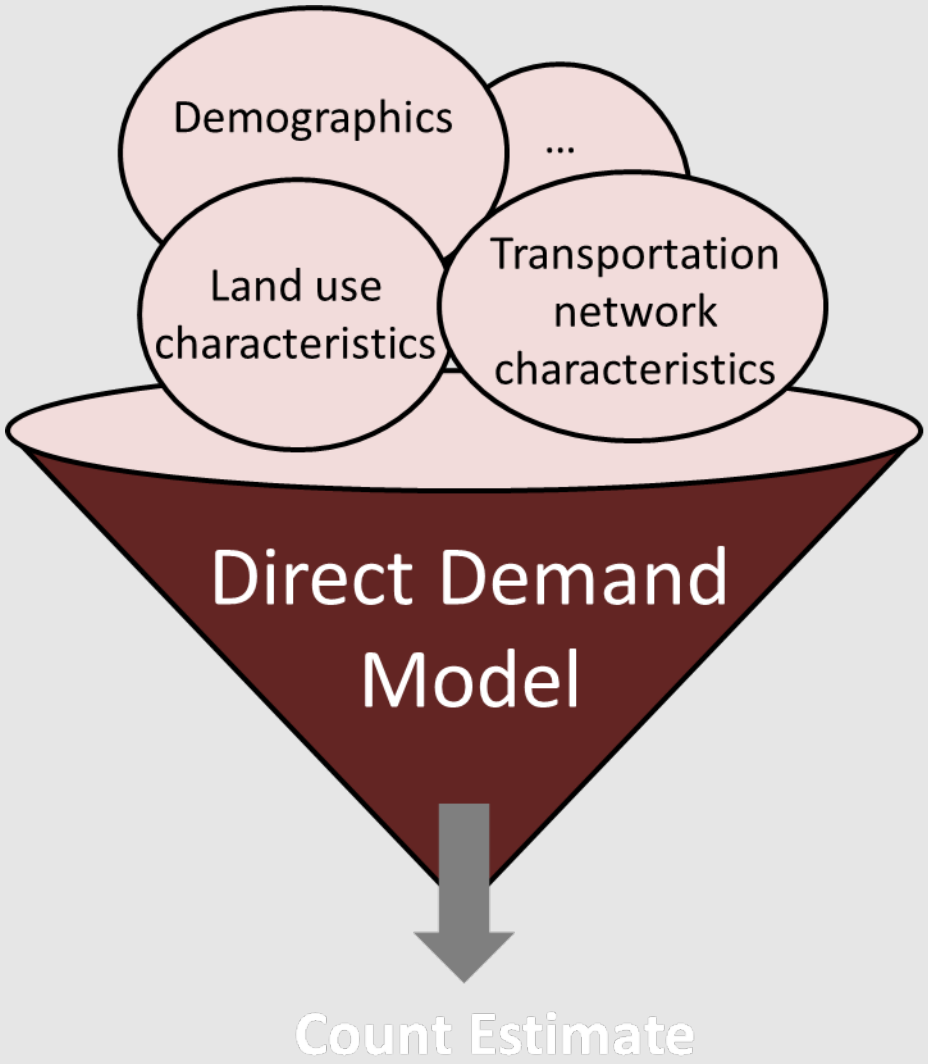
Model Development Process



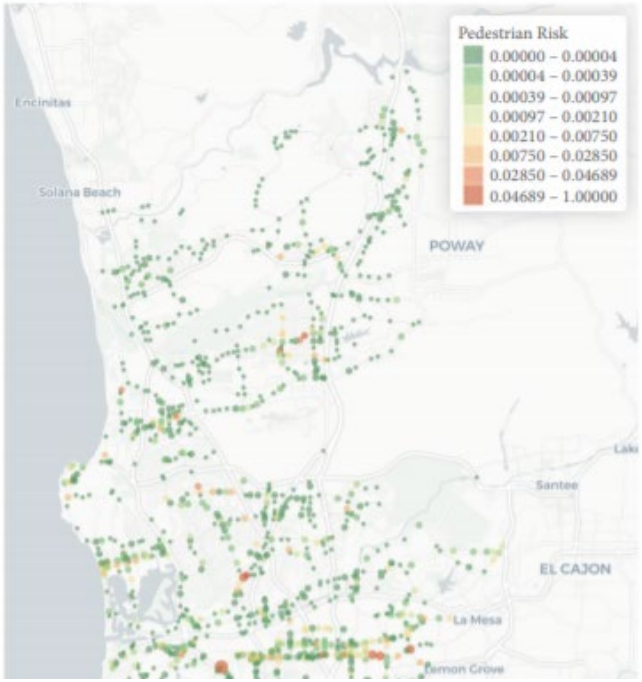


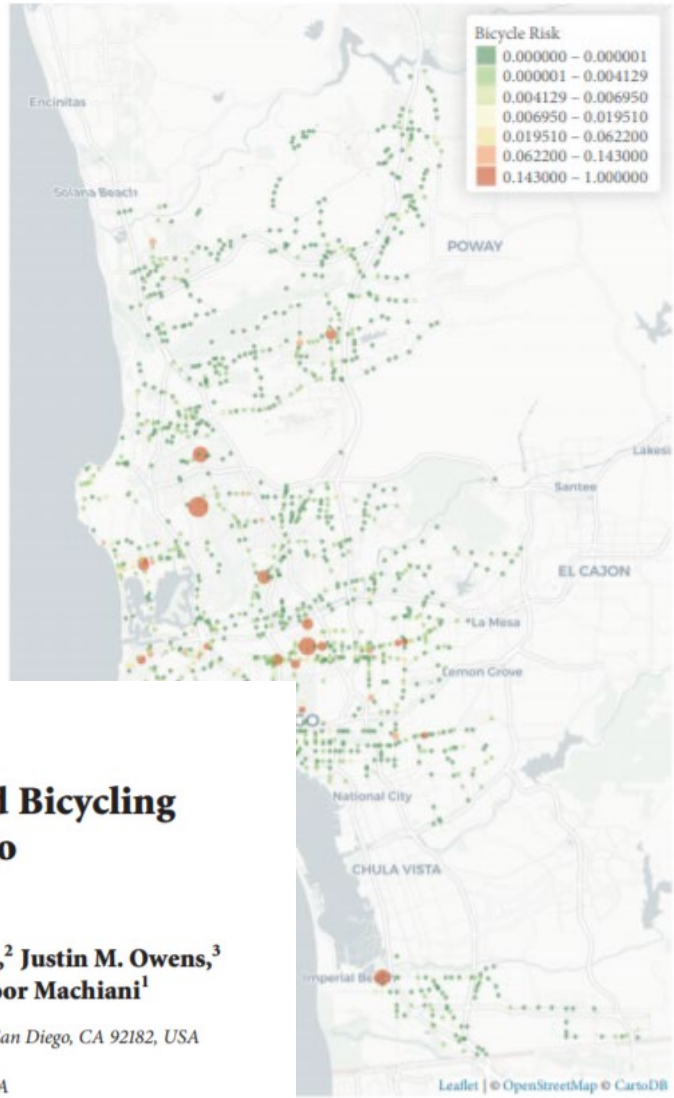
Build & Apply

- **Build** to estimate at locations where the count data are collected
- **Apply** to predict at locations where the count data not available



Example 1: San Diego Non-motorized Safety Study





Research Article

Identifying High-Risk Intersections for Walking and Bicycling Using Multiple Data Sources in the City of San Diego

Mahdie Hasani,[1] Arash Jahangiri,[1] Ipek Nese Sener,[2] Sirajum Munira,[2] Justin M. Owens,[3] Bruce Appleyard,[4] Sherry Ryan,[4] Shawn M. Turner,[5] and Sahar Ghanipoor Machiani[1]

[1]*Civil, Construction, and Environmental Engineering, San Diego State University, 5500 Campanile Dr, San Diego, CA 92182, USA*
[2]*Texas A&M Transportation Institute, 505 E. Huntland Dr., Austin, TX 78752, USA*
[3]*Virginia Tech Transportation Institute, 3500 Transportation Research Plaza, Blacksburg, VA 24061, USA*
[4]*School of Public Affairs, San Diego State University, 5500 Campanile Dr, San Diego, CA 92182, USA*
[5]*Texas A&M Transportation Institute, 3135 TAMU, College Station, TX 77843, USA*

http://downloads.hindawi.com/journals/jat/2019/9072358.pdf

Example 1: Nonmotorized Volume Estimates in San Diego

- Pedestrian & Bicycle Direct Demand Model results

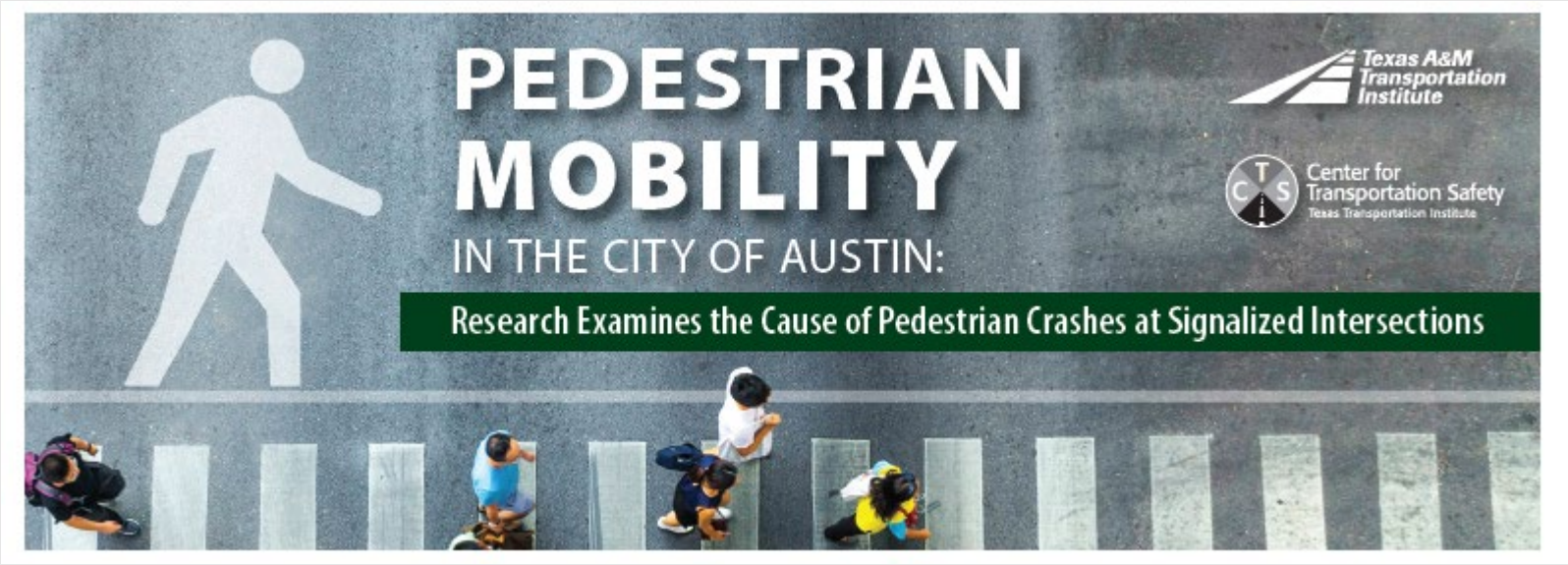
Pedestrian Model (buffer in mile)	Est
Transit stop density (0.5)	8.78**
Regular transit rider, pedestrian, or bicyclist population % (0.25)	3.71*
Employment density (0.25)	0.05**
Maximum speed limit <40 mph	1.13**
% of vacant housing units (0.5)	−3.51**
Commercial/mixed-use land area (0.1)	0.19**
If the area contains a higher crime count than the average (0.25)	−0.29*

** Significant at 0.05 level; * Significant at 0.1 level

Bicycle Model (buffer in mile)	Est
Regular bicyclist population (0.25)	0.01**
Transit stop density (0.1)	0.85
Maximum speed limit <40 mph	0.45**
Distance from beachfront access point ≤10 miles	0.37**
Presence of a school (0.5)	−0.48**
Bike facility density (0.5)	1.37**
Total commercial or mixed-use land area (0.25)	0.02**

http://downloads.hindawi.com/journals/jat/2019/9072358.pdf

Example 2: Austin Pedestrian Safety Study



ELSEVIER

Accident Analysis & Prevention
Volume 144, September 2020, 105679

A Bayesian spatial Poisson-lognormal model to examine pedestrian crash severity at signalized intersections

Sirajum Munira, Ipek N. Sener, Boya Dai

Texas A&M Transportation Institute, 505 E Huntland Dr, Austin, TX 78752, United States

https://www.sciencedirect.com/science/article/abs/pii/S0001457519317968?dgcid=rss_sd_all

Example 2: Pedestrian Volume Estimates in Austin

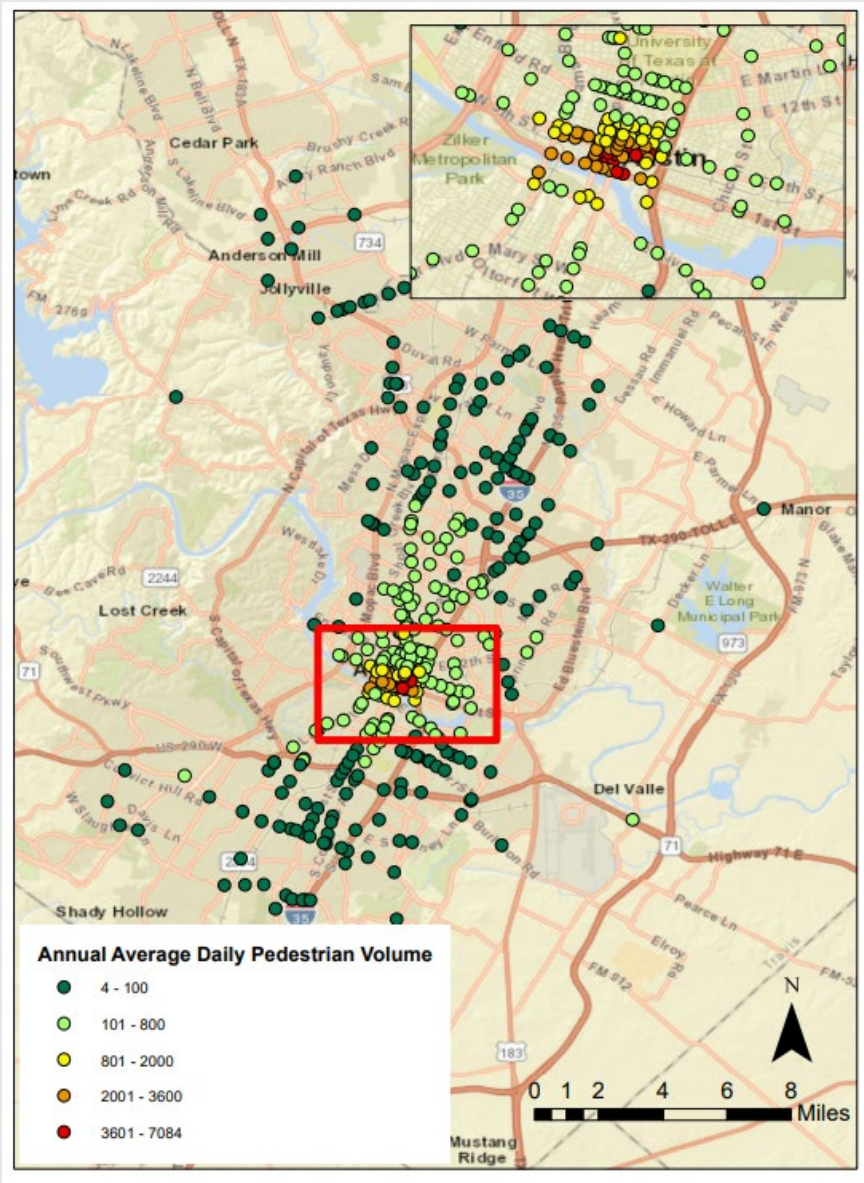
Need to estimate pedestrian exposure at (signalized) intersections citywide

Count data
- Available at 44 sites

Pedestrian Direct Demand Model

Count estimate
- Applied to 409 intersections

Crash model



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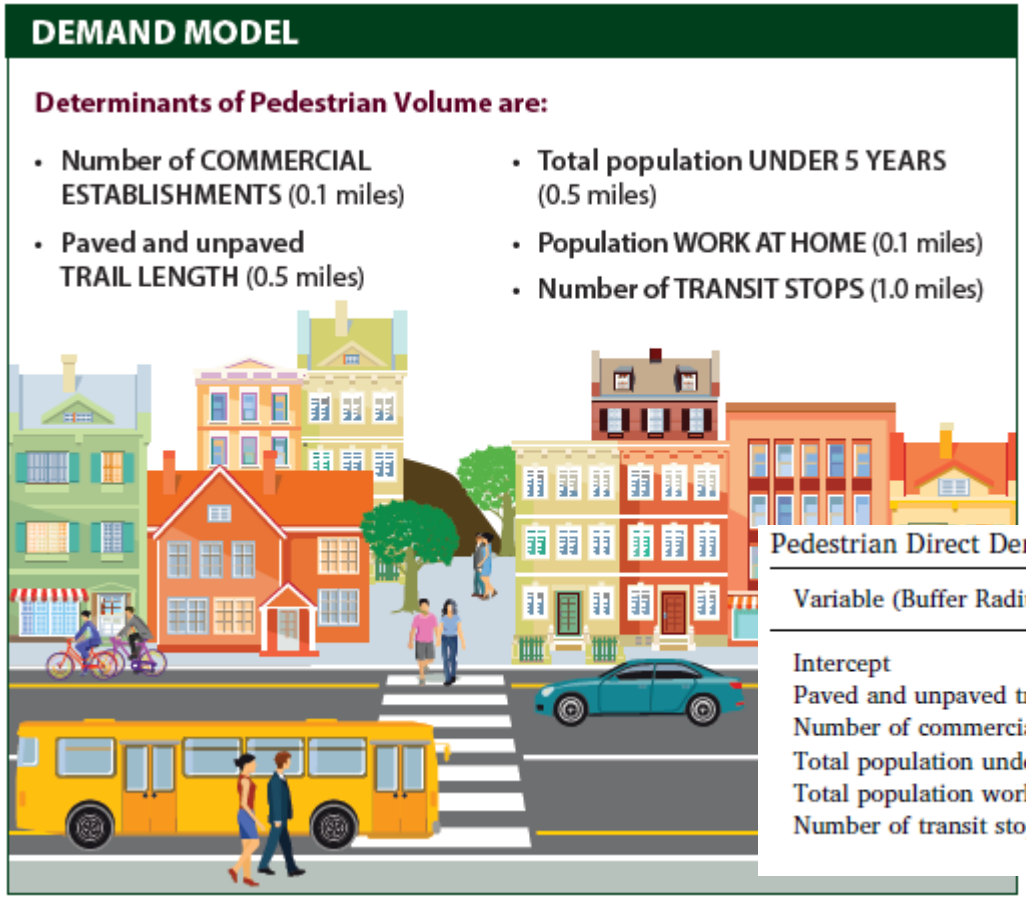
Example 2: Pedestrian Volume Estimates in Austin

- Pedestrian Direct Demand Model results



- Trail network
- Transit facility
- Land use
- Demographics

Pedestrian Direct Demand Model Results.

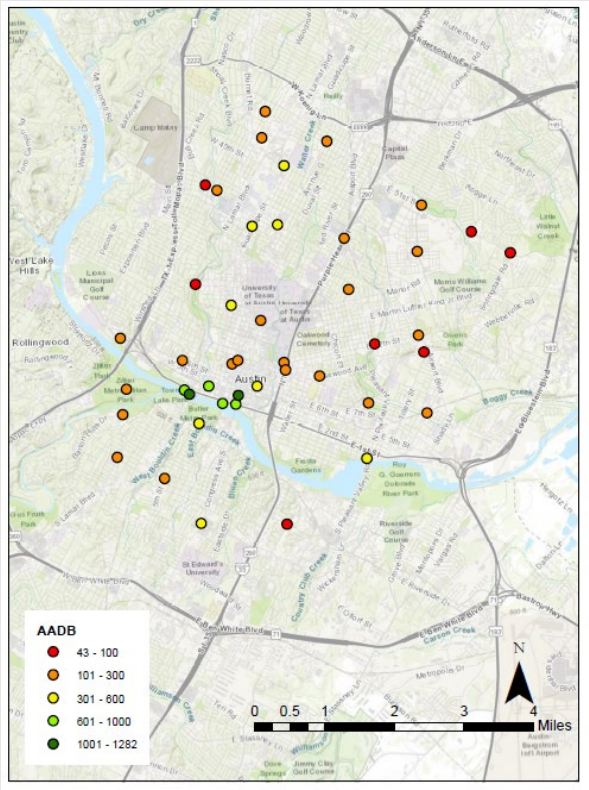
Variable (Buffer Radius)	Estimate	T-Stat	Pr(> |z|)
Intercept	4.088	8.21	< 0.001
Paved and unpaved trail length in feet (0.5 miles)	6.37e-05	4.86	< 0.001
Number of commercial establishments (0.1 miles)	2.39e-02	2.44	0.01
Total population under 5 years (0.5 miles)	−3.72e-03	−3.17	< 0.001
Total population working at home (0.1 miles)	6.10e-02	4.14	< 0.001
Number of transit stops (1.0 miles)	8.96e-03	2.61	0.01

https://www.sciencedirect.com/science/article/abs/pii/S0001457519317968?dgcid=rss_sd_all

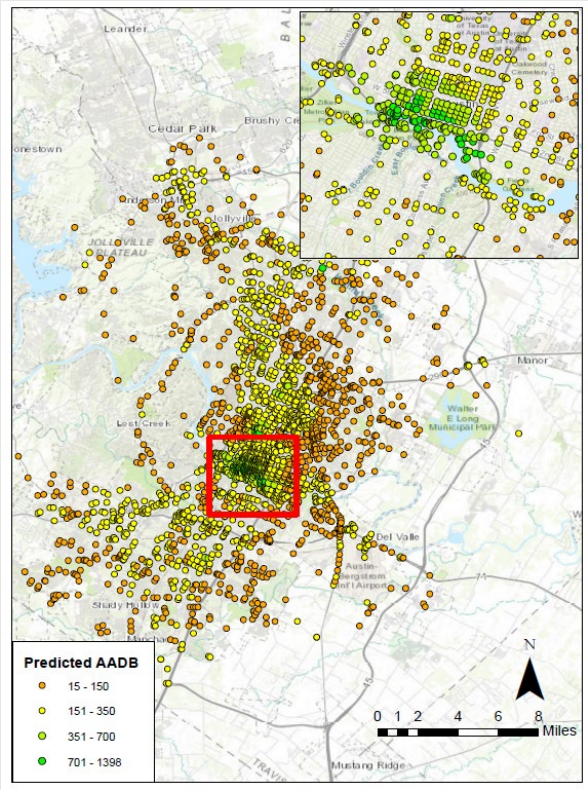
Example 3: Austin Bicycle Demand Study (work in progress)

- Development of a bicycle direct demand model
- Use of a composite measure
  - a bikeability index to quantify the bike friendliness of the road network
- Other model variables include demographics and land-use characteristics

Count data available at 44 sites (intersections)

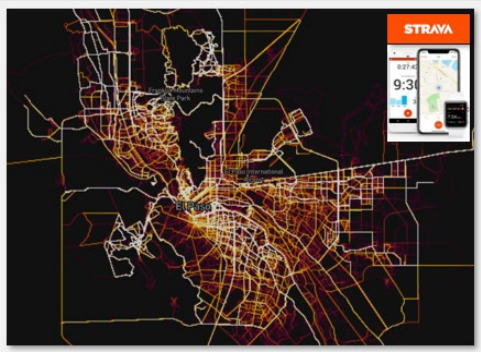


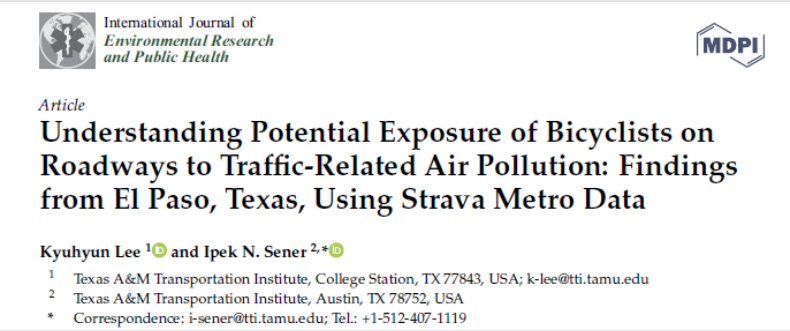
Count estimate applied to 2,518 intersections



Example 4: El Paso Bicycle Patterns Study

- A model to explore bicycling activity in the city (*focus on exposure to air pollution*)
  - Count data --> Crowdsourced data (StravaMetro)
    - valuable input in estimating bike/ped demand
    - need to be aware of challenges (e.g. sample bias)





International Journal of *Environmental Research and Public Health*

MDPI

Article

Understanding Potential Exposure of Bicyclists on Roadways to Traffic-Related Air Pollution: Findings from El Paso, Texas, Using Strava Metro Data

Kyuhyun Lee [1] and Ipek N. Sener [2,*]

1 Texas A&M Transportation Institute, College Station, TX 77843, USA; k-lee@tti.tamu.edu
2 Texas A&M Transportation Institute, Austin, TX 78752, USA
* Correspondence: i-sener@tti.tamu.edu; Tel.: +1-512-407-1119

Bicycle Model results

Category	Variable Name		Estimate	T-Stat.
Roadway characteristics	Posted speed limit	48 km/h (30 mph) or less	−0.327	−5.56
		56 km/h (35 mph)	−0.481	−7.22
		64 km/h (40 mph)	−0.298	−4.84
	Roadway type	Collector	−0.569	−10.39
		Local street	−1.361	−8.05
Bicycle infrastructure characteristics	Planned bike facilities		0.678	12.44
	Existing bike facilities	Off-street path	1.474	13.54
		Buffered bike lane	1.340	11.16
		Shared lane marking	1.047	6.10
		Bike lane	0.886	10.19
Topographical attributes	Elevation (100 m)		0.402	6.77
	Segment slope (%)		0.017	1.85
	District	West Franklin Mt.	0.424	4.93
		East Franklin Mt.	−0.796	−8.84
		East downtown	−0.492	−6.59
		South El Paso	−0.585	−6.67
		East-South El Paso	−0.697	−8.50
Neighborhood demographics	Age	People aged 35–44 (%)	0.702	1.75
		People aged 45–54 (%)	2.030	4.23
	Ethnicity	Hispanic (%)	0.465	2.72
	Socioeconomics	Median household income ($10,000)	0.096	7.06
		Retail job density (1000 per sq. km)	−0.259	−3.94
Emission exposure measures	Bus frequency (100 times per day)		0.339	7.32
	(Natural log of) $PM_{2.5}$ (gram/min/km)		0.146	9.11
	Constant		−1.496	−2.13

https://www.mdpi.com/1660-4601/16/3/371

Using Bicyclist and Pedestrian Count Data

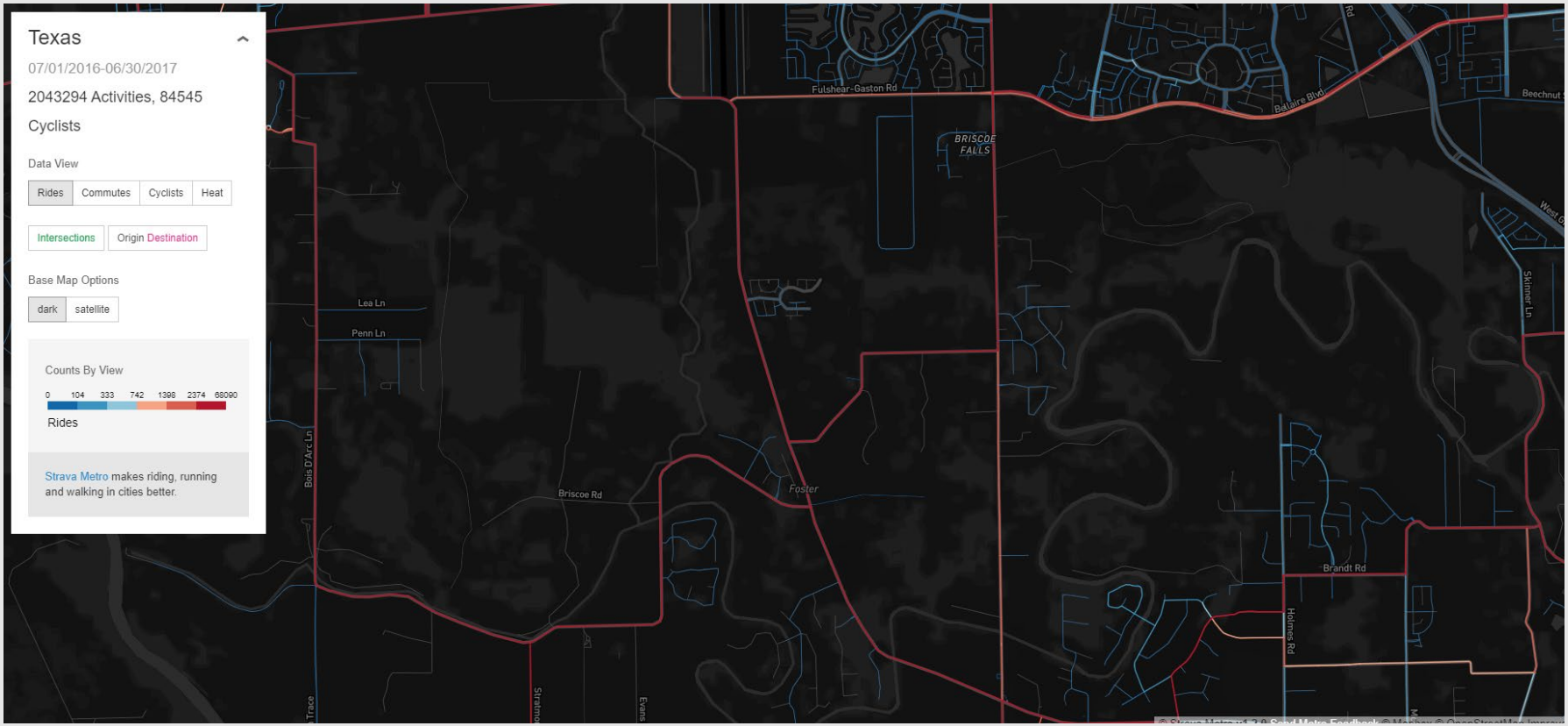
Operations, Maintenance, and TSM Origin Destination (OD) Project Selection

Robert Benz

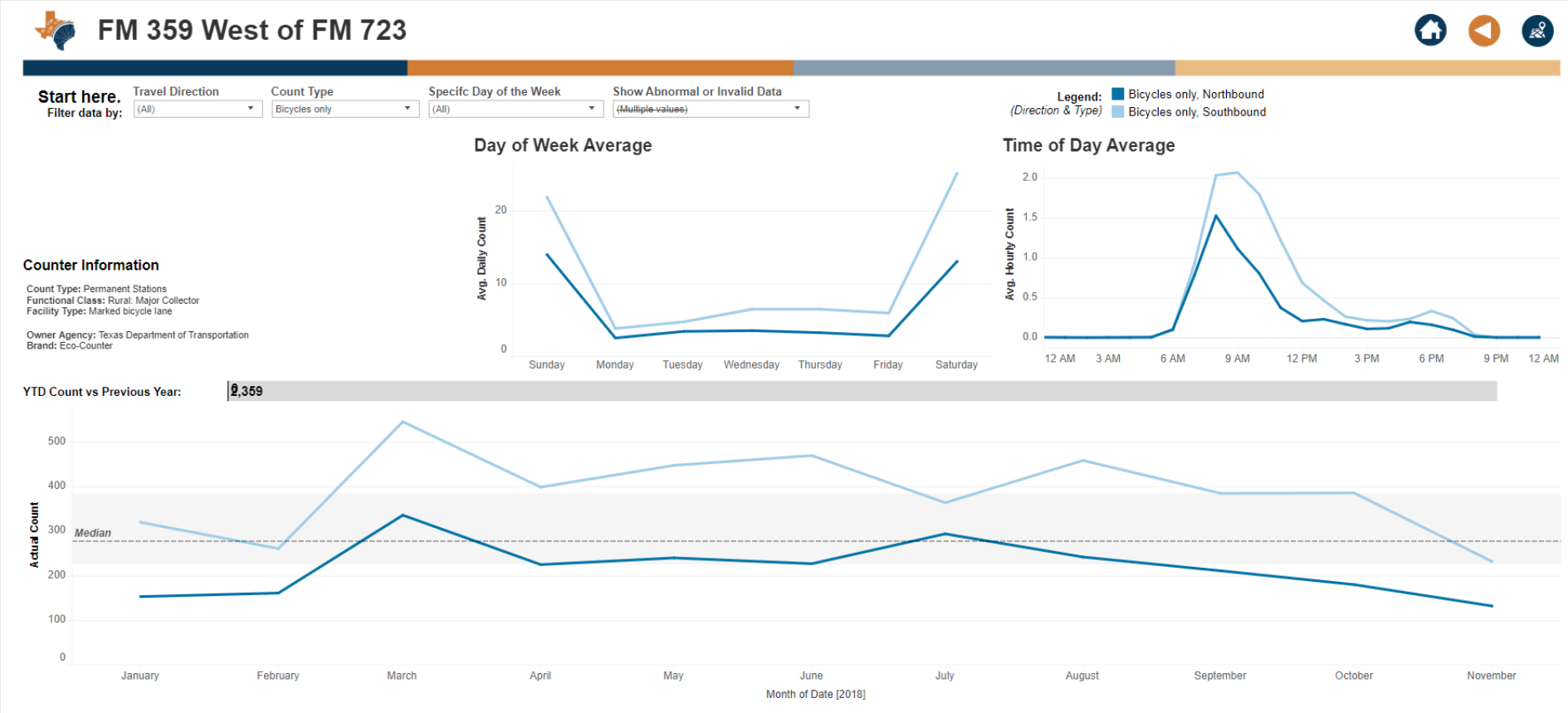
- Rumble Strip Example

Operations, Maintenance, TSM

- Rumble Strip Example
- Strava Estimate

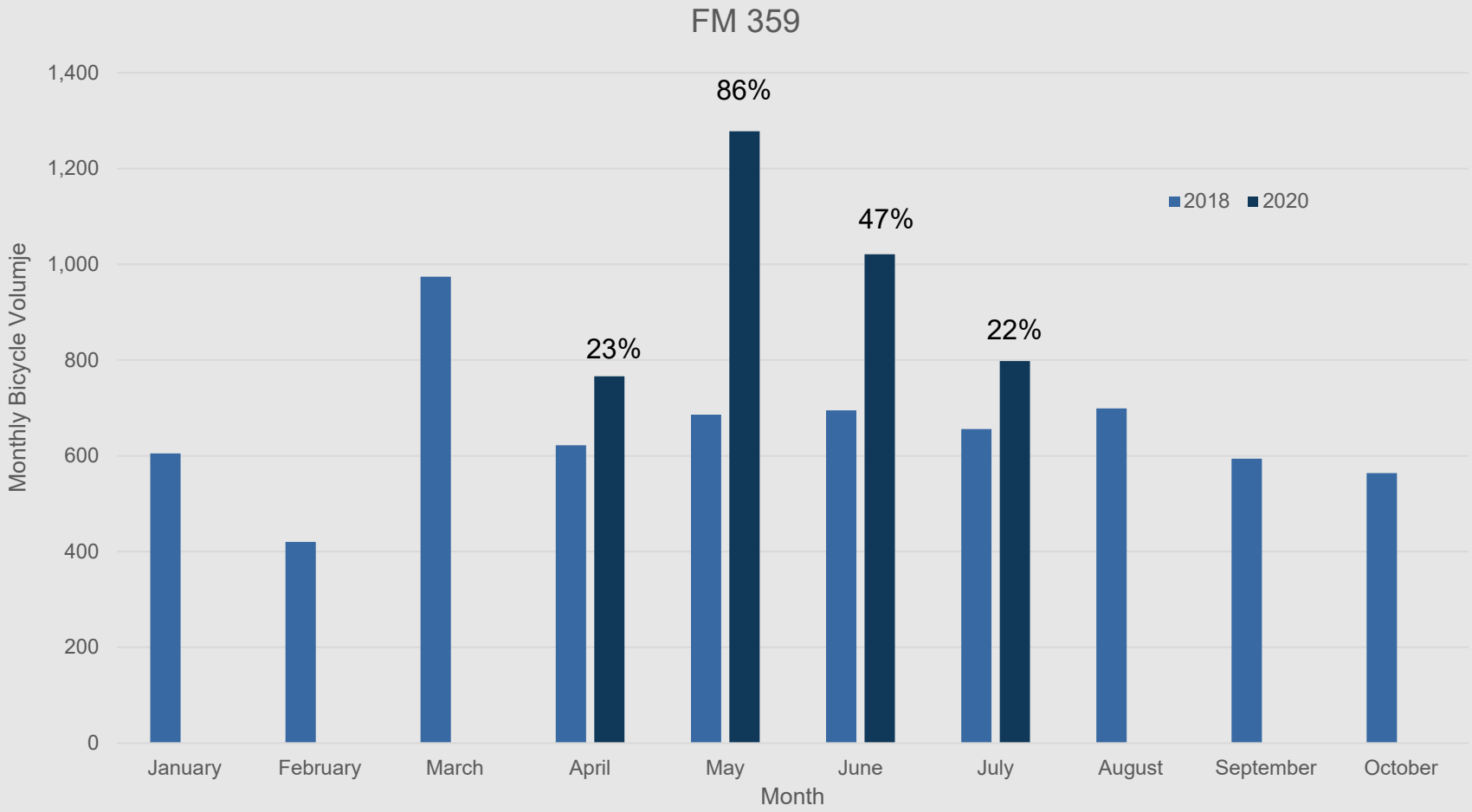


- Rumble Strip Example
- Compare Permanent or Short Duration Counts to Strava Estimate

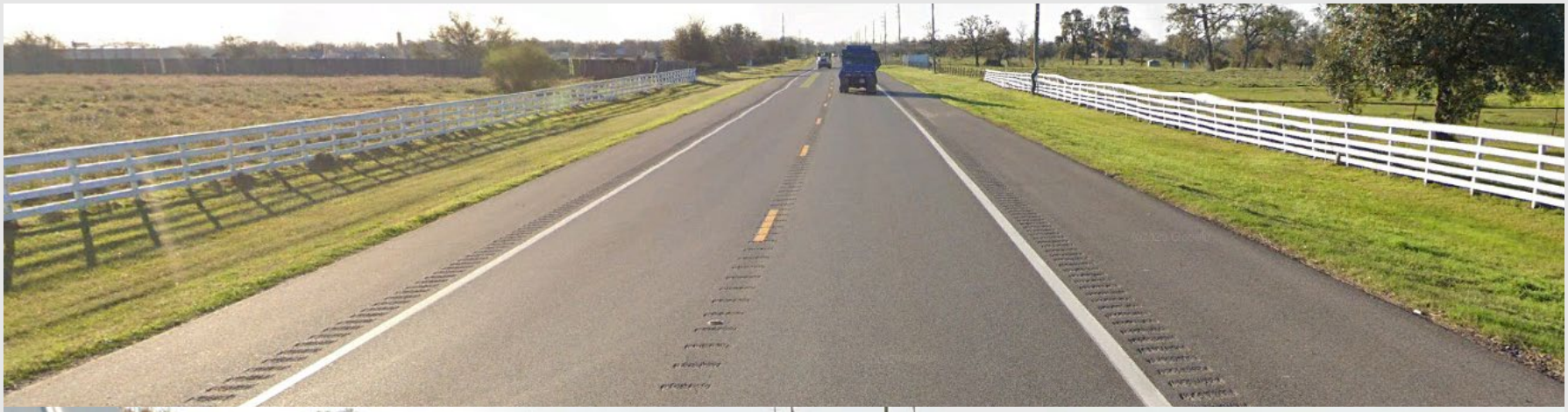


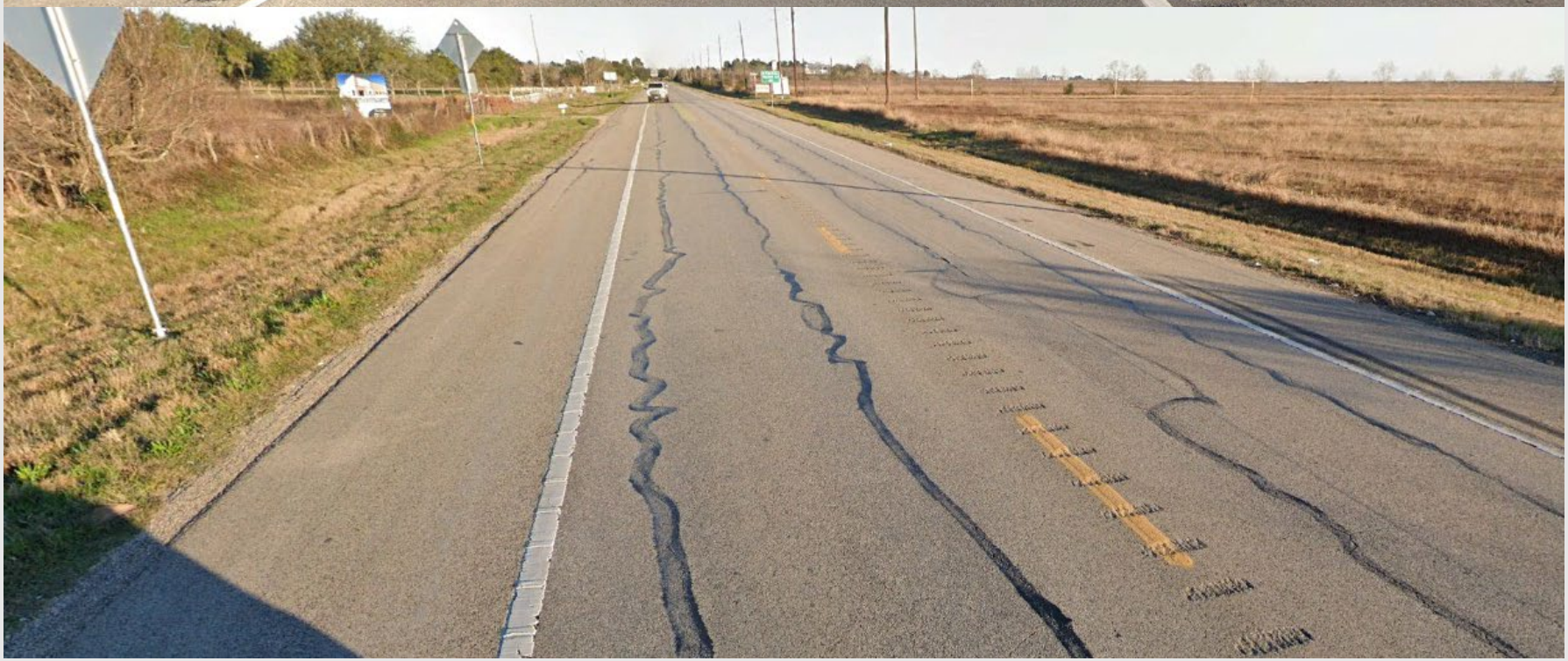
Operations, Maintenance, TSM

- Rumble Strip Example
- Compare Permanent or Short Duration Counts to Strava Estimate



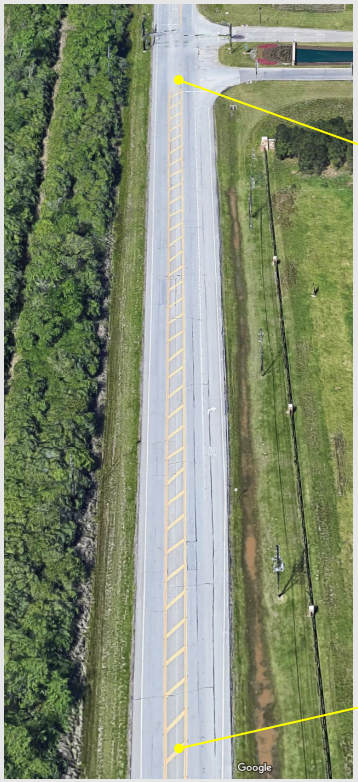
Operations, Maintenance, TSM

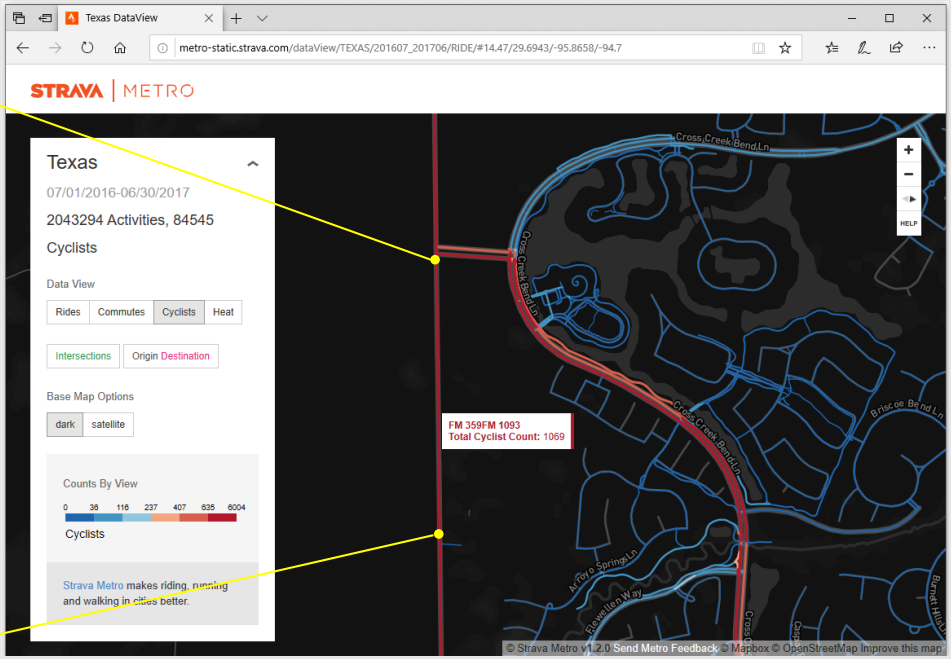




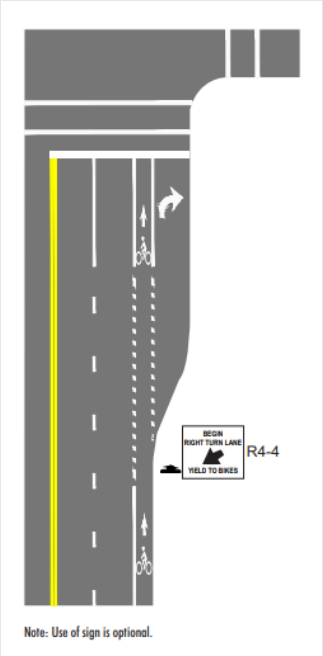
TxDOT Houston District

- New right-turn lane for property development
- Strava Metro Data shows 1,069 cyclists during 2016-2017
- Integrated bike lane treatment



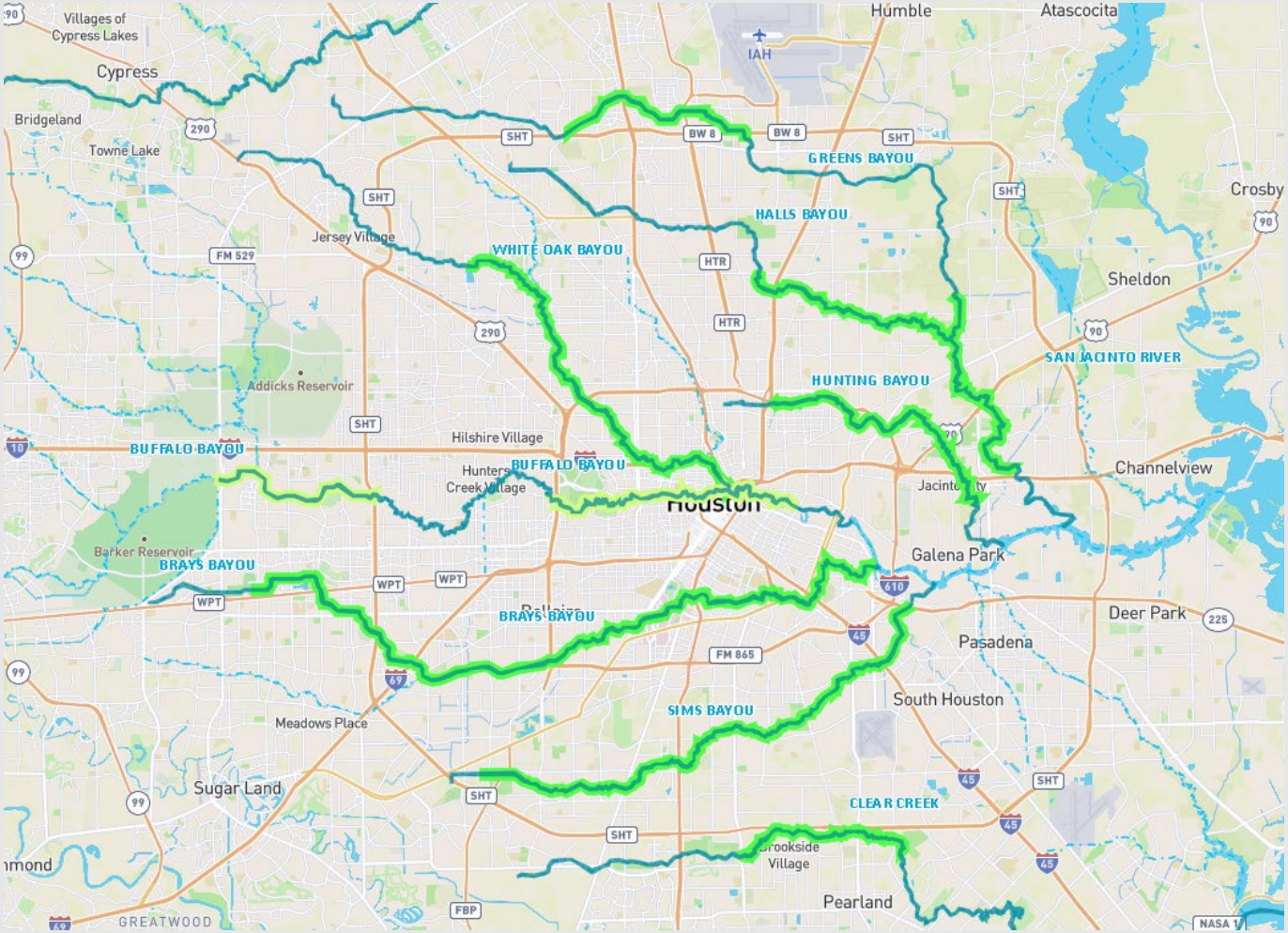


Source: http://metro-static.strava.com/dataView/TEXAS/201607_201706/RIDE/#7.72/31.155/-96.972

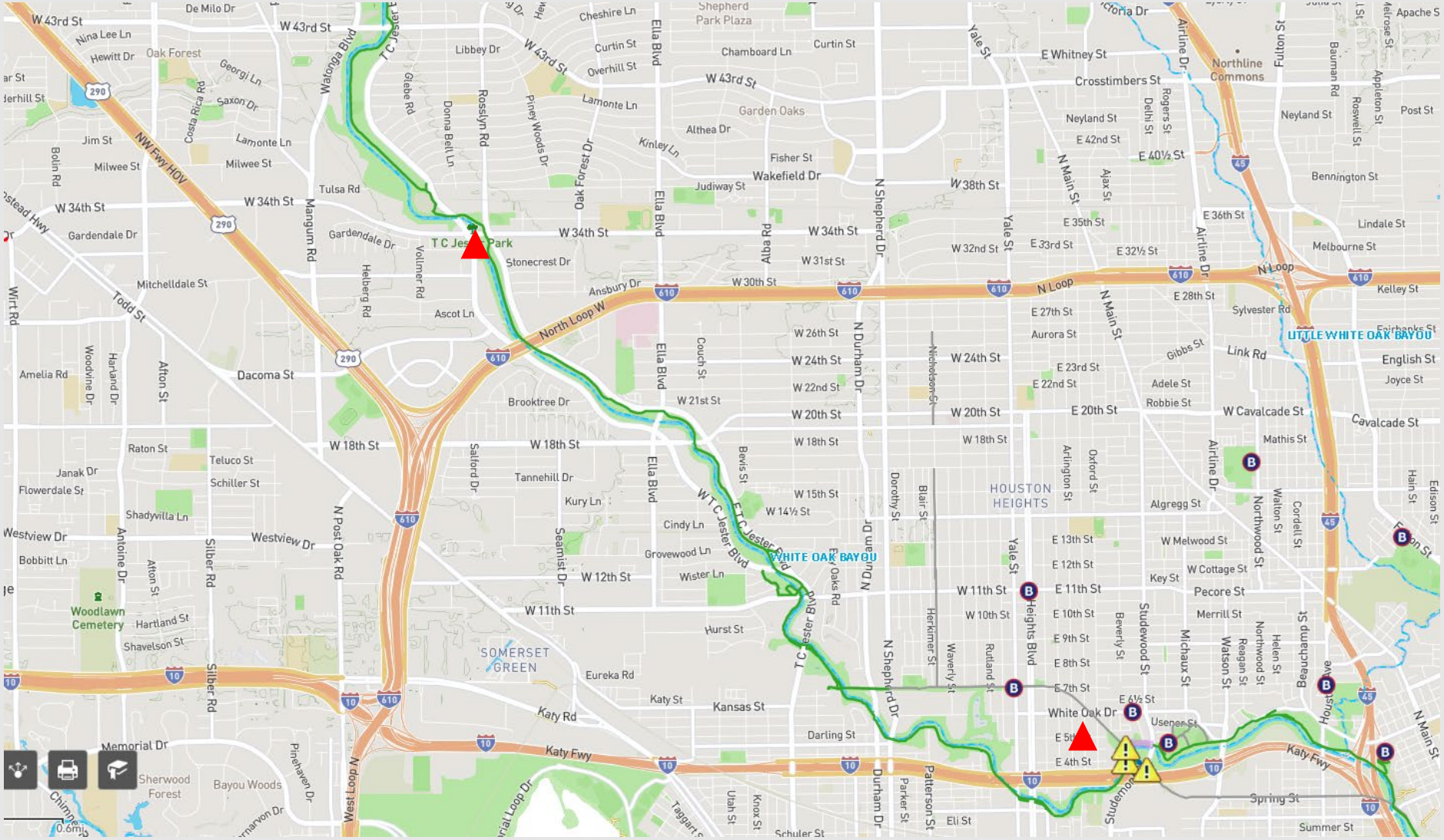


Origin Destination (OD)

- If you have a trail and know the count where are people entering and exiting the system?

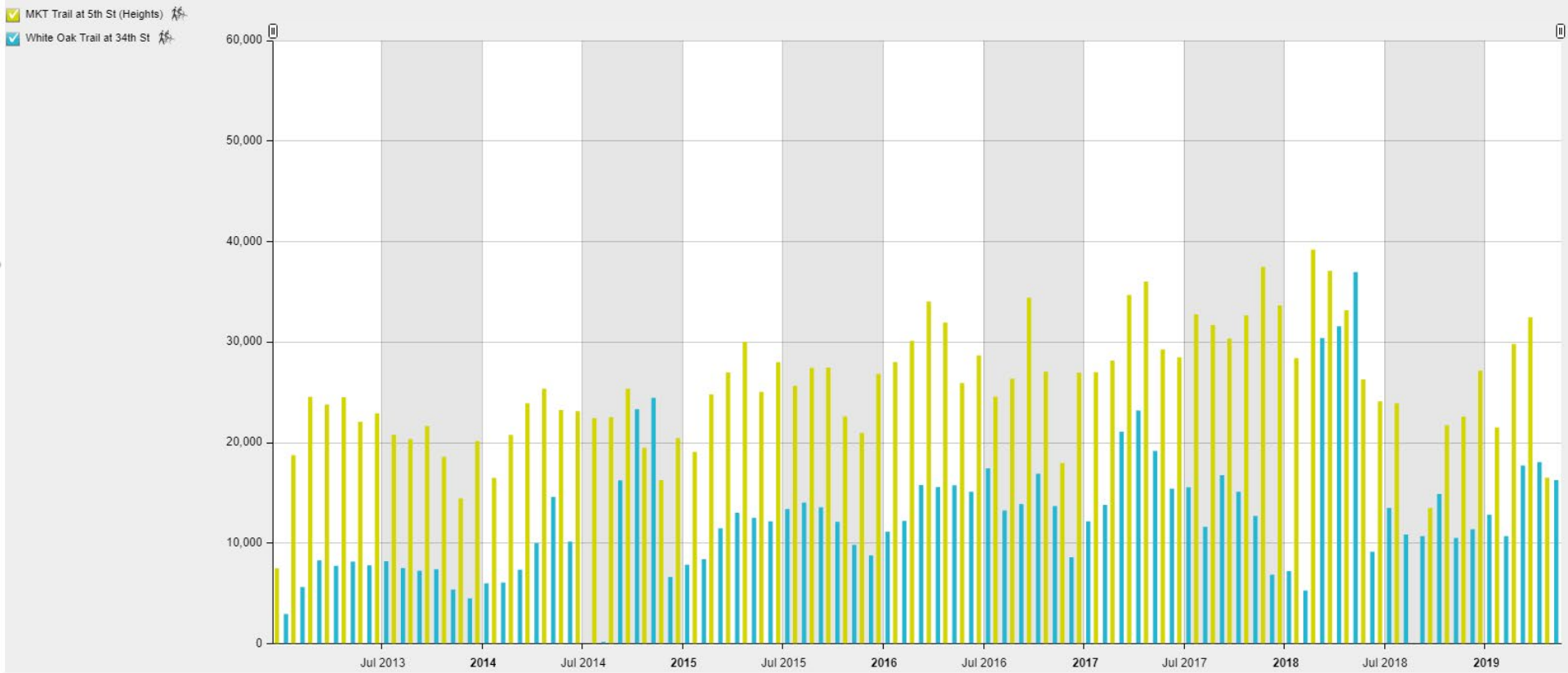


Origin Destination (OD)

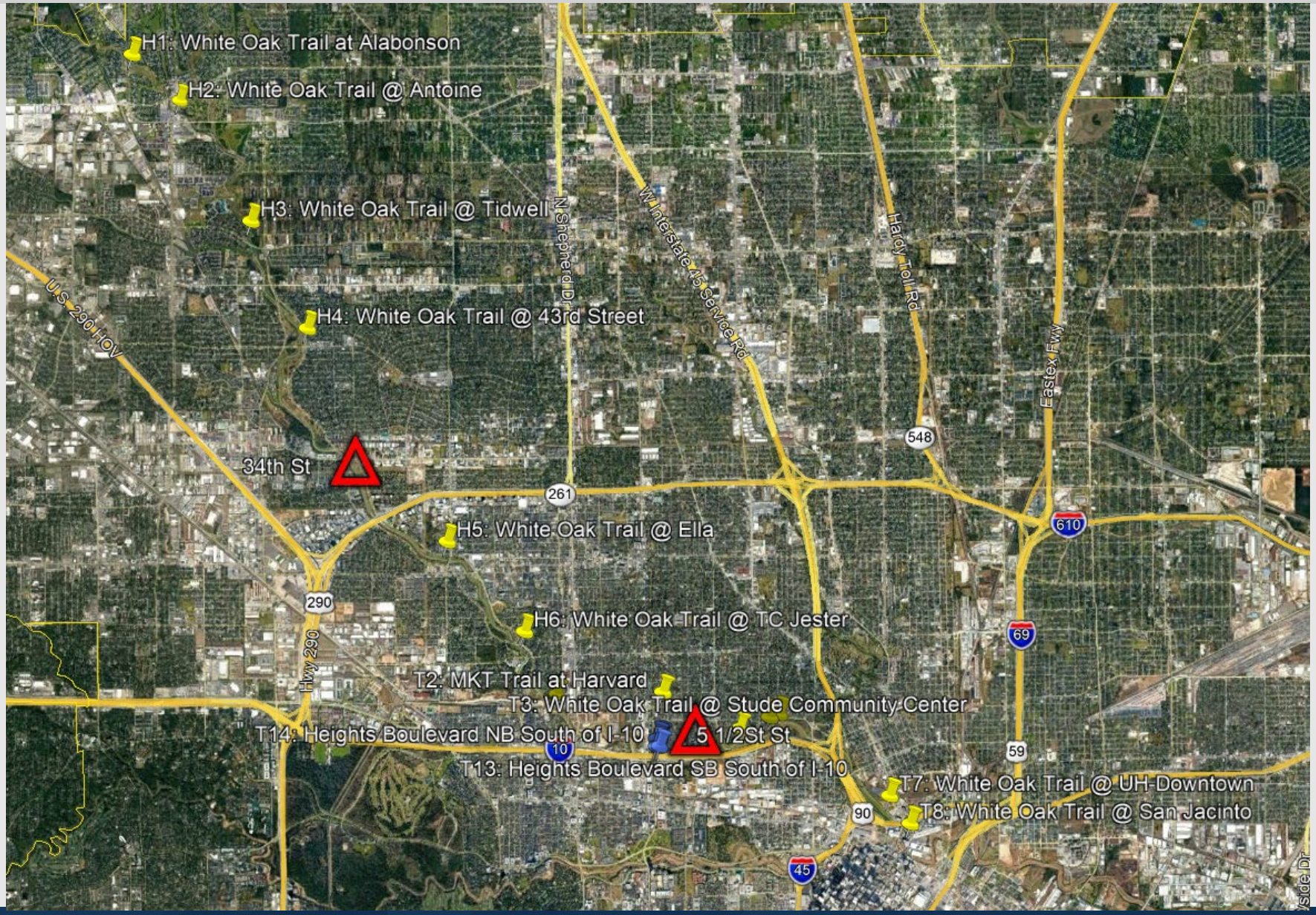


Origin Destination (OD)

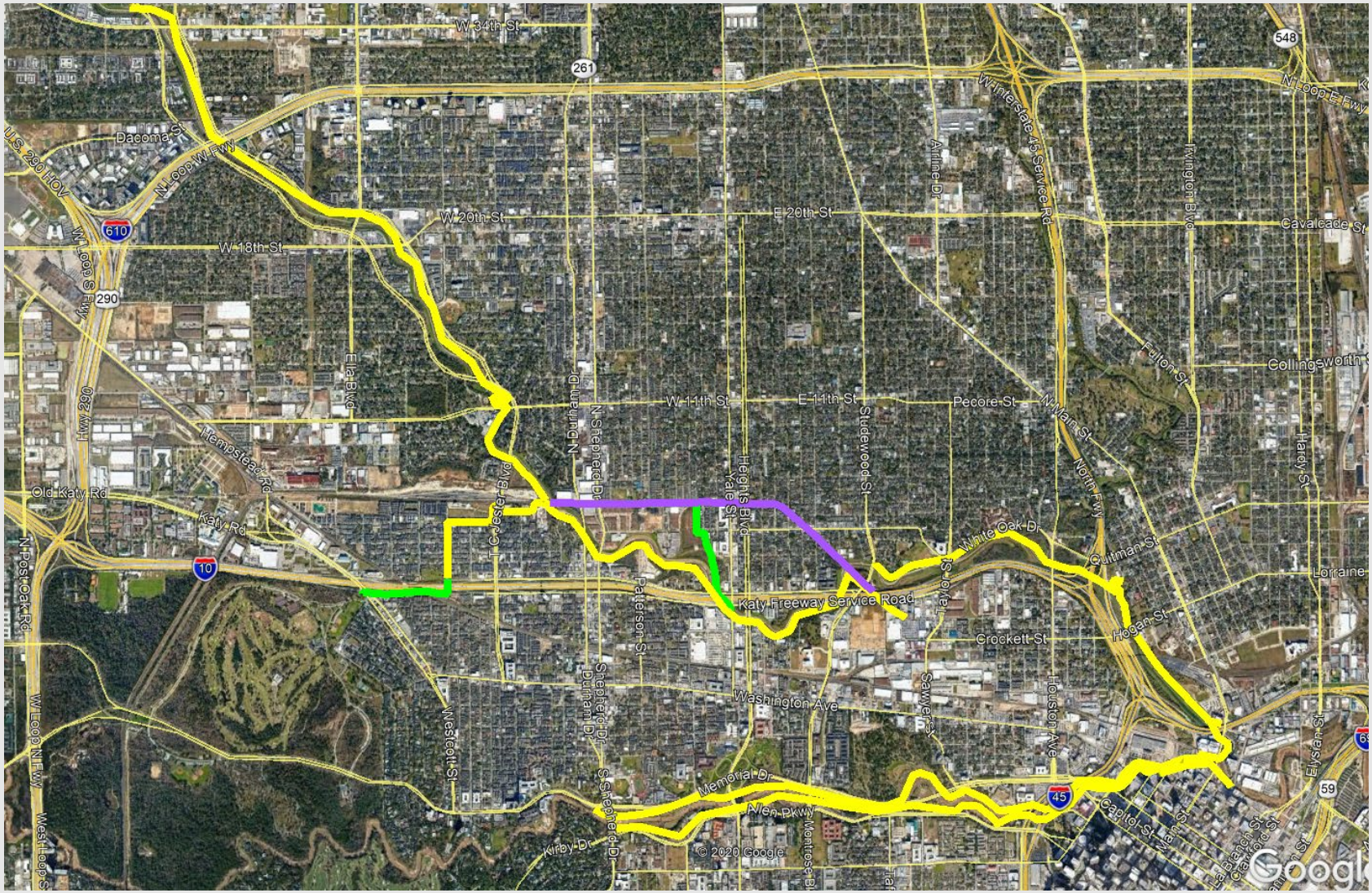
- Where are users accessing the trail between these two permanent counters?



Origin Destination (OD)



Project Selection



Project Selection Criteria

- Multi Source Estimates
- Existing Counts
- Strava
- ACS
- Demand Estimation
- Variation
- Field Visit

Identifying/Prioritizing/Selecting Projects

- TIP call for projects estimation process
- Selection based on the benefit-cost ratio (safety and reduction of SOV)
- Estimate of non-motorized users per project required

			% increase per yea		2%	1/2 mile walk							
			Number of years		20	0.5							
Non Motoized Project Volume Estimates													
#	Project Length	Stava Compnts	Strava Vol	Step increase	Step Vol	Distance Factor	2040 Vol	Existing Count Estimate	Distance Factor	2040 Vol	Conslt Est	Conslt 2025	Conslt 2045
1	0.9337	30	30	1.3	39	72.8	108	35	65.4	97			
2	0.5843	135+175(.3	187.5	1.2	225	262.9	391	150	175.3	260	2090		4,187
3	0.7911	35+35	70	1.2	84	132.9	198	114	180.4	268	2521		3,009
4	0.98	125	125	1.2	150	294.0	437	94	184.2	274			
5	1.1279	50	50	1.2	60	135.3	201	32	72.2	107			
6	8.8061	55-95	75	1.2	90	1585.1	2,355	20	352.2	523	2210		2,604
7	0.0511	30	30	1.5	45	45.0	67	45	45.0	67	2237		2,234
8	0.1083	40	40	1.2	48	48.0	71	30	30.0	45			
9	2.0797	75	75	1	75	312.0	464	70	291.2	433	2339		2,347
11	2.2033	(35+25)	60	1.2	72	317.3	471	50	220.3	327	469		552

Module #3: Using Pedestrian and Bicyclist Count Data

- Questions?

Phil Lasley

Bonnie Sherman

- MODULE 3, USING THE DATA
  - Introduction & Overview
  - Before & After Study
  - Trend Monitoring
  - Safety Analysis
  - Demand Estimation
  - Operation, Maintenance, and TSM
  - OD Patterns
  - Planning & Project Selection
  - Other Uses

Shawn Turner

Robert Benz

Ipek N. Sener