PBIC Webinar

Pedestrian and Bicycle Count Data
Part 2 – Equipment

Krista Nordback
UNC Highway Safety Research Center

Frank Proulx
Alta Planning + Design

Sarah O'Brien
NCSU Institute for Transportation Research and Education

Today's Presentation

- Introduction and housekeeping
- Presentations
- Questions at the end

Webinar Issues

- **Audio issues?**
  Dial into the phone line instead of using "mic & speakers."
- **Webinar issues?**
  Re-Load the webpage and log back into the webinar. Or send note of an issue through the Question box.
- **Questions?**
  Submit your questions at any time in the Questions box.

CM Credits and Email

⇨**Certificate of Attendance**

You will receive a certificate of attendance by email from the UNC Highway Safety Research Center

Pedestrian and Bicycle Information Center

Dear James,

Thank you for registering for "A Resident's Guide for Creating Safer Communities for Walking and Biking".

The Federal Highway Administration just released "A Resident's Guide for Creating Safer Communities for Walking and Bicycling," a free guide offering step-by-step instructions for residents and community groups looking to improve pedestrian and bicyclist safety, access, and comfort. This webinar offers an overview of the guide and will review how two communities used the principles outlined within it to make their communities more walkable and bikeable.

Tamara Redmon, with FHWA's Office of Safety, will introduce the guide and discuss how it fits within the US Department of Transportation's Safer People, Safer Streets Initiative.

Laura Sandt, with the Pedestrian and Bicycle Information Center, will discuss the content of the new guide and how residents can use it.

PBIC Webinars and News

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Upcoming Webinars

- **Upcoming session on counts:**
  - APBP Webinar on June 21:
    Beyond Counting - Putting the Data to Work for Better Planning and Evaluation (visit www.apbp.org)

- **PBIC's next webinar:**
  - March 14 session co-sponsored with GHSA:
    Laying the Groundwork for Successful Safety Education and Enforcement Activities

    (visit www.pedbikeinfo.org/webinars)

Pedestrian and Bicycle Count Programs

Krista Nordback, P.E., Ph.D.

THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY RESEARCH CENTER

www.hsrc.unc.edu

Tuesday, February 21, 2017

Agenda – Review of Part 1

- Why count?
- Basics of traffic count programs
  - Permanent
  - Short Duration
- Evolution of nonmotorized counting
- Resources
- Recap from Tuesday

Why measure biking and walking?

If we don't count it, it doesn't count.

What?

People actually walk here?

Evolution of Nonmotorized traffic counting

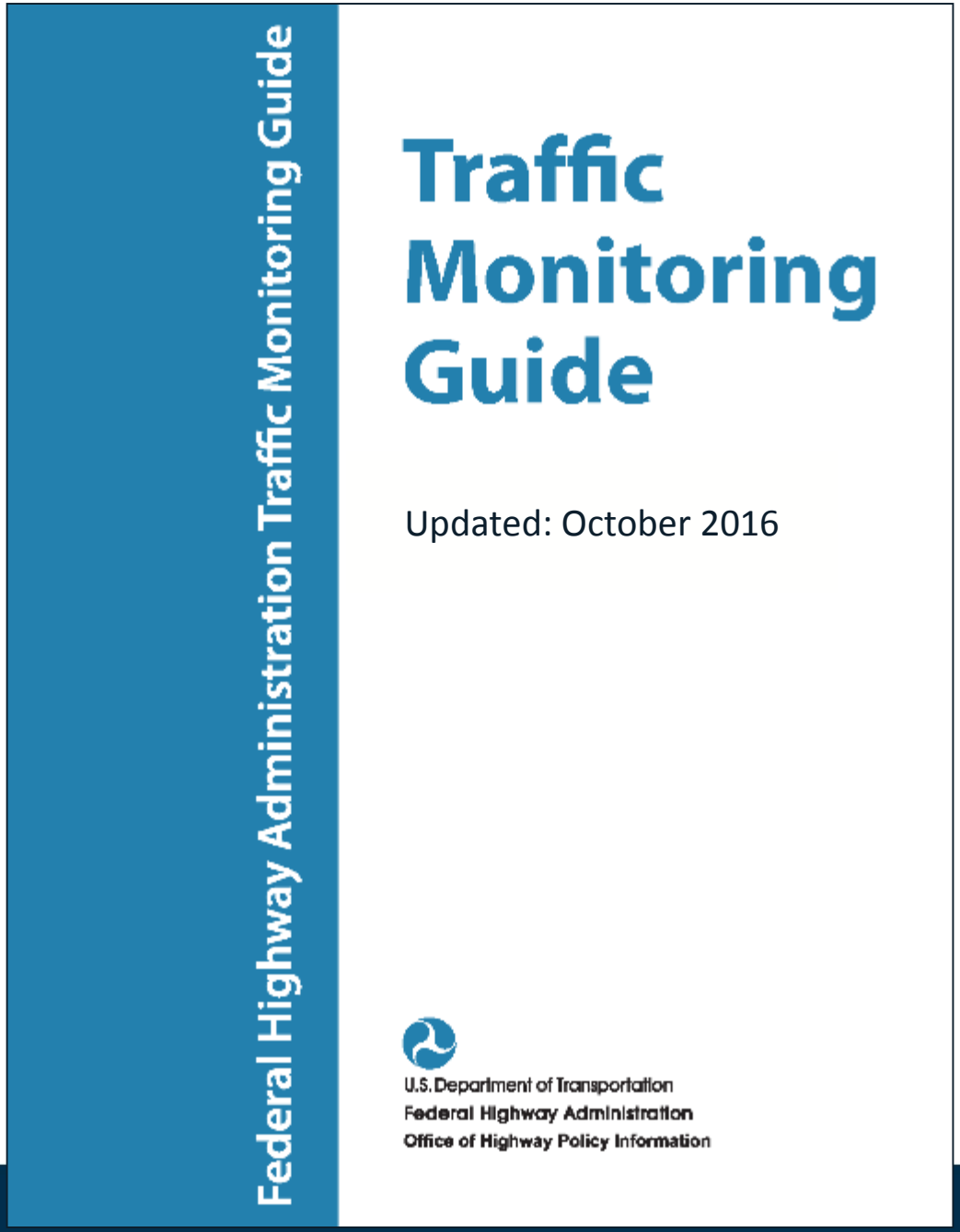
Short duration: Manual

Permanent and Short Duration: Automated

*Traffic Monitoring Guide 2013:**6***

Chapter 4 for Nonmotorized Traffic

Section 7.9 & 7.10 for nonmotorized data format



AADPT & AADBT: Annual Average Daily Pedestrian and Bicycle Traffic

AADT for walking and cycling!

A Multi-Pronged Approach to Cyclist and Pedestrian Counting

- The FHWA Traffic Monitoring Guide identifies three main types of count programs

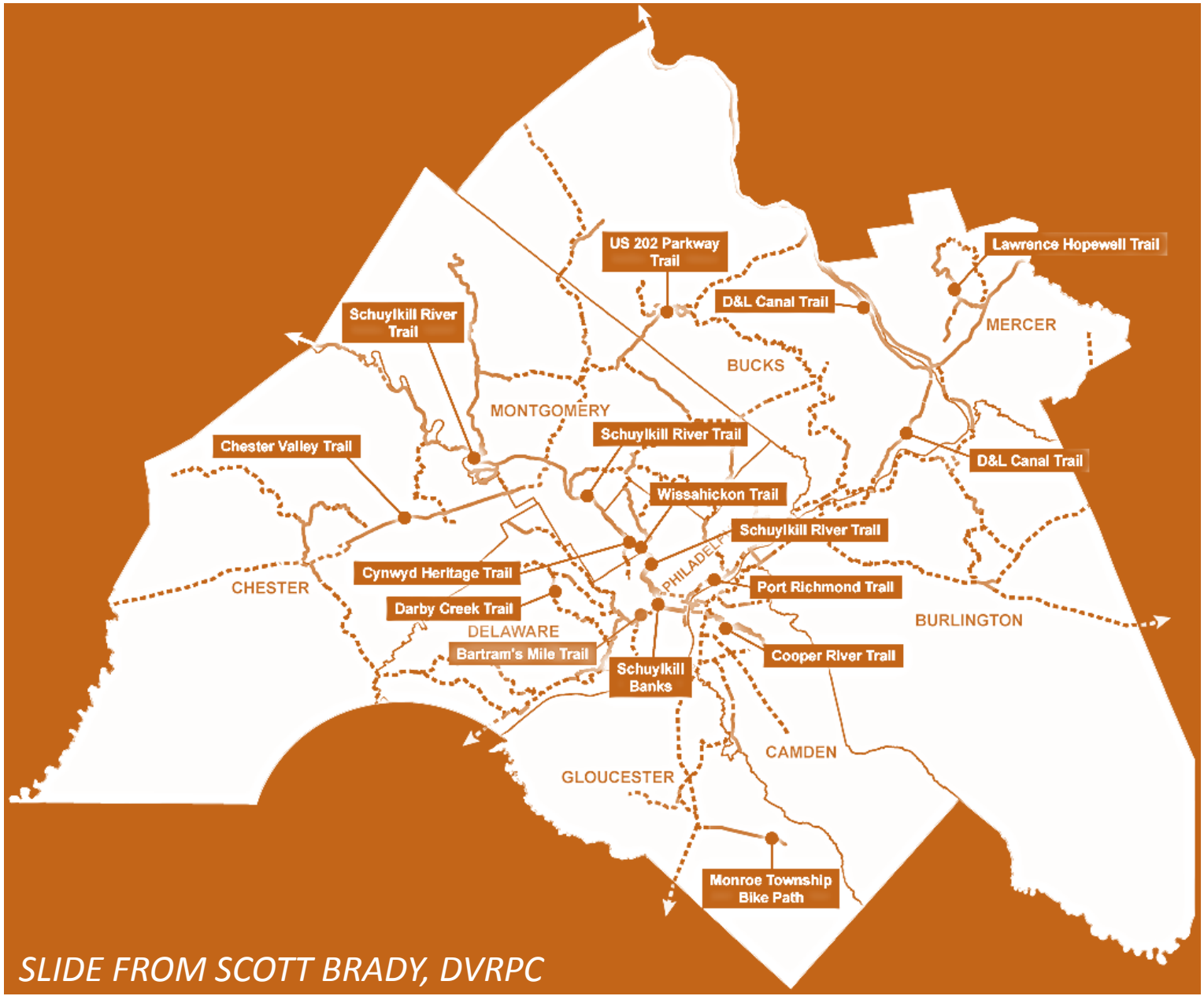
Permanent Count Program

Cyclical Count Program

Project Counts

SLIDE FROM SCOTT BRADY, DVRPC

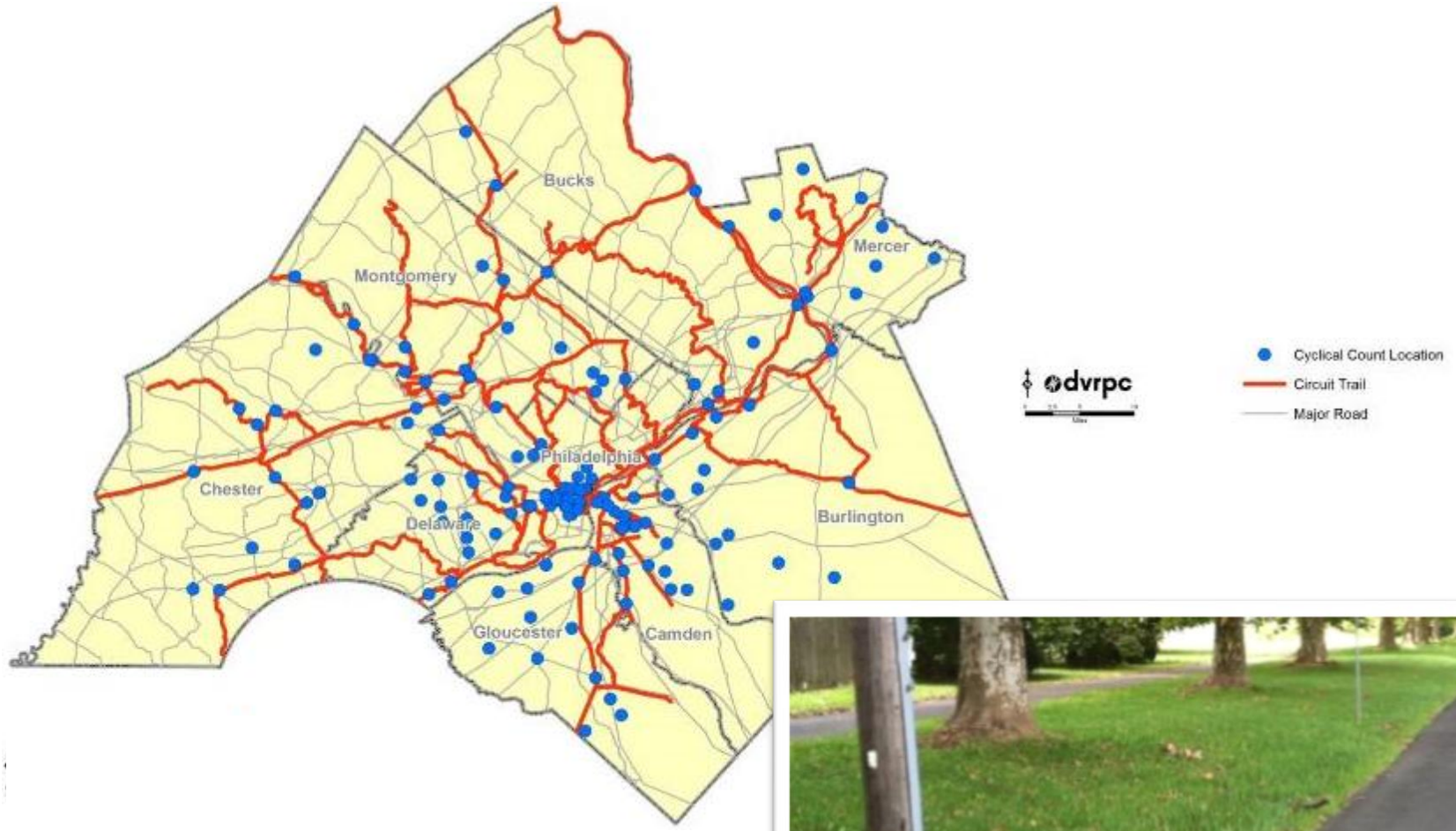
Trail Permanent Count Stations



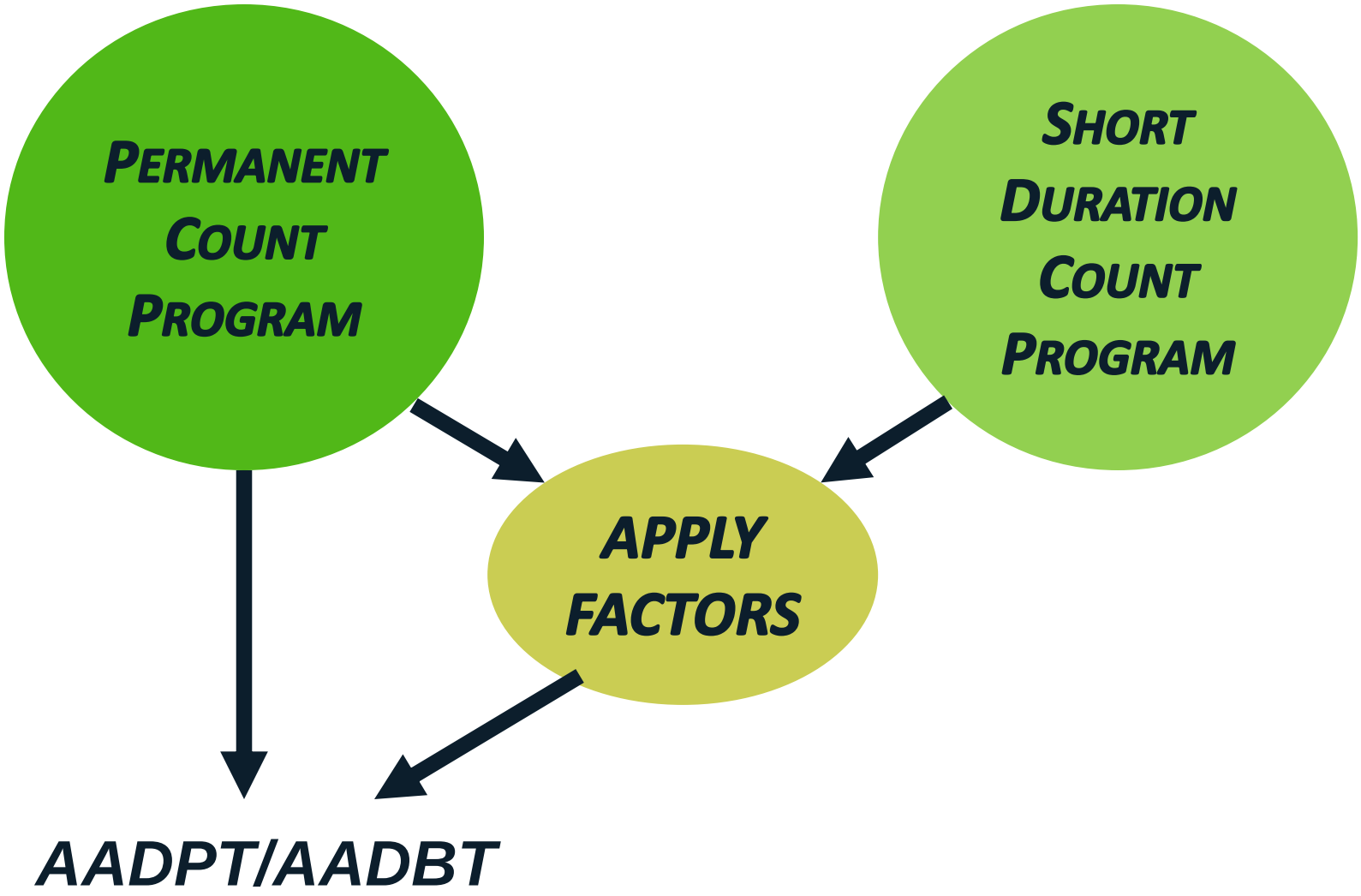
SLIDE FROM SCOTT BRADY, DVRPC


PERMANENT
COUNT
PROGRAM
AADPT/AADBT

Locations – Cyclical Count Program



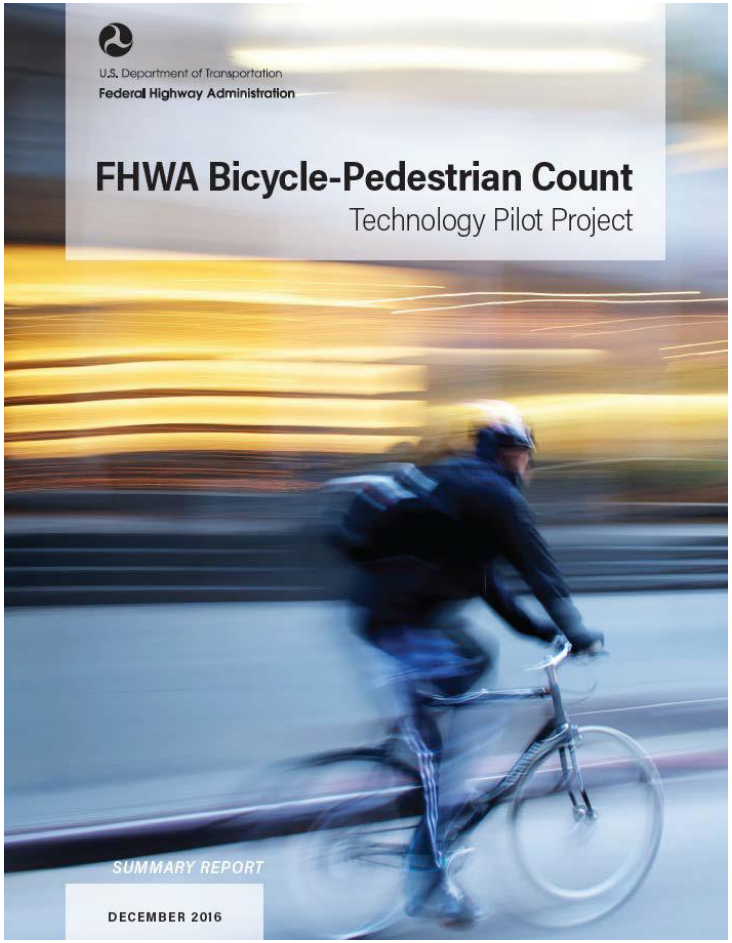
SLIDE FROM SCOTT BRADY, DVRPC


PERMANENT COUNT PROGRAM
SHORT DURATION COUNT PROGRAM
APPLY FACTORS
AADPT/AADBT

Info from Part 1 of the Webinar:

Jeremy Raw, Federal Highway Administration (FHWA)

- Bike/Ped Count Technology Pilot https://www.fhwa.dot.gov/environment/bicycle_pedestrian/countpilot/
- Travel Monitoring Analysis System (TMAS) to accept bike/ped count data in 2017
- Webinar Poll results:
  - 38% want to use and contribute data to TMAS

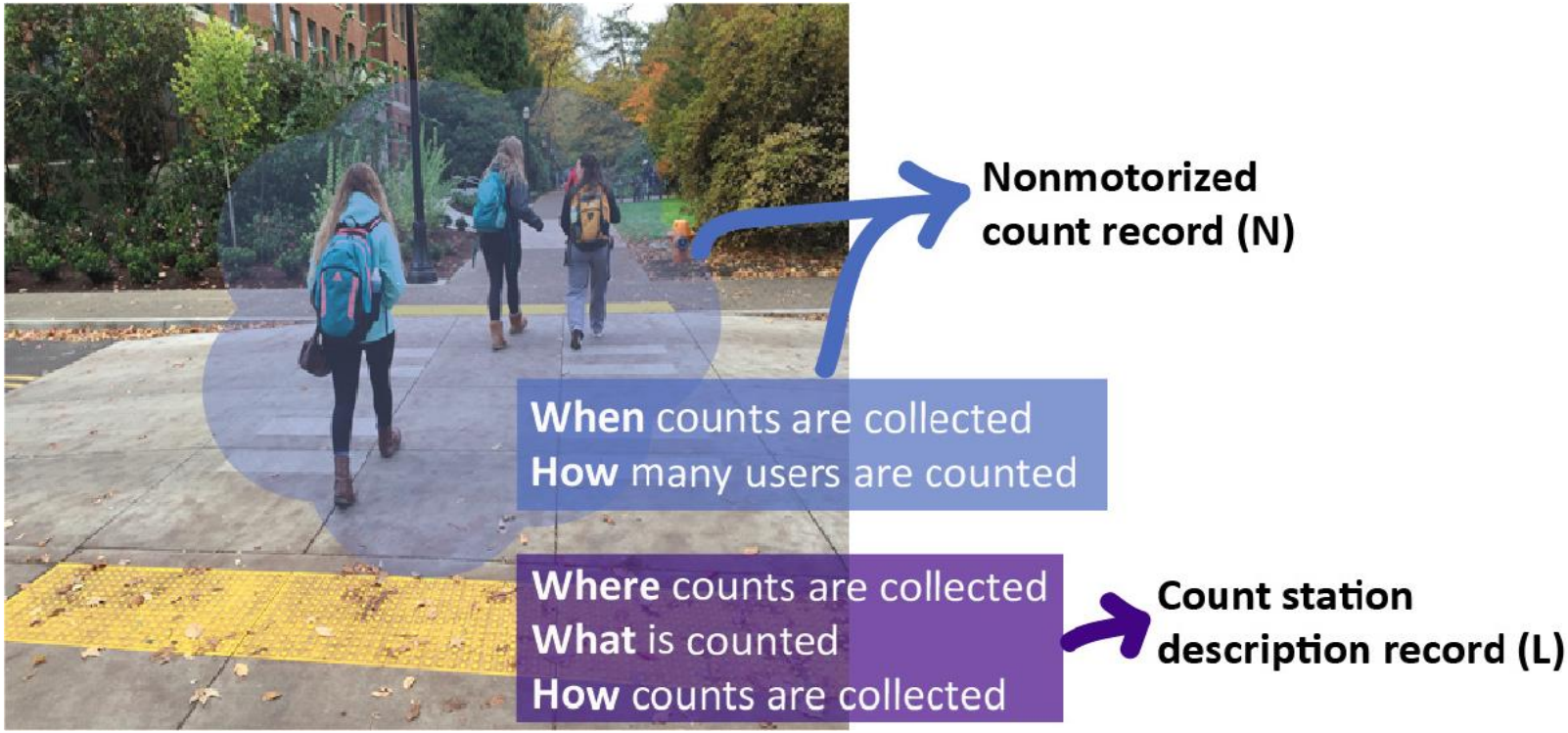


Info from Part 1 of the Webinar:

Kelly Laustsen, Kittelson & Associates

- FHWA Guide for coding TMG nonmotorized format

  https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/tmg_coding/



Recommendations

- Use permanent counters AND short duration counters
- Short duration counts:
  - 7 days
  - Count in high volume months
- Validate equipment
- Share data

Thanks!

Krista Nordback, P.E., Ph.D.
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919-962-3493

EQUIPMENT FOR COUNTING BIKING AND WALKING

Frank Proulx, Ph.D.
frankproulx@altaplanning.com

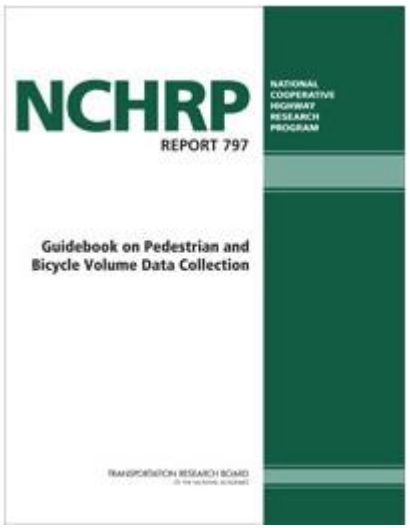
OVERVIEW

- What technologies are available?
- What's the right tool for the job?

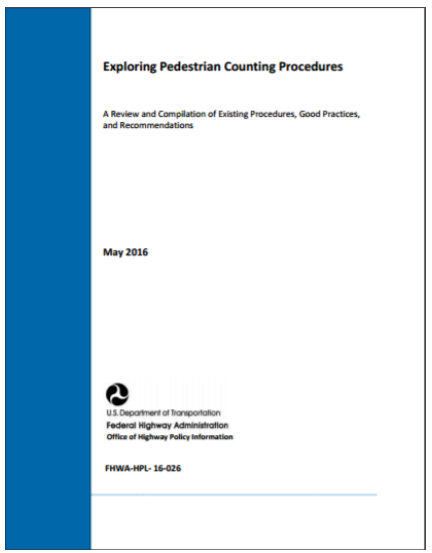
SOURCE MATERIAL

- NCHRP 797 (Kittelson lead) http://www.trb.org/Main/Blurbs/171973.aspx

Round 2: Web-Only Document 229, in publication!



- Exploring Pedestrian Counting Procedures http://www.dot.state.mn.us/research/TS/2013/201324.pdf



TYPES OF COUNTERS

How Long?

Short-Duration

365

Continuous

Who?

Pedestrians

Bicyclists

Both

Lump Sum

Where?

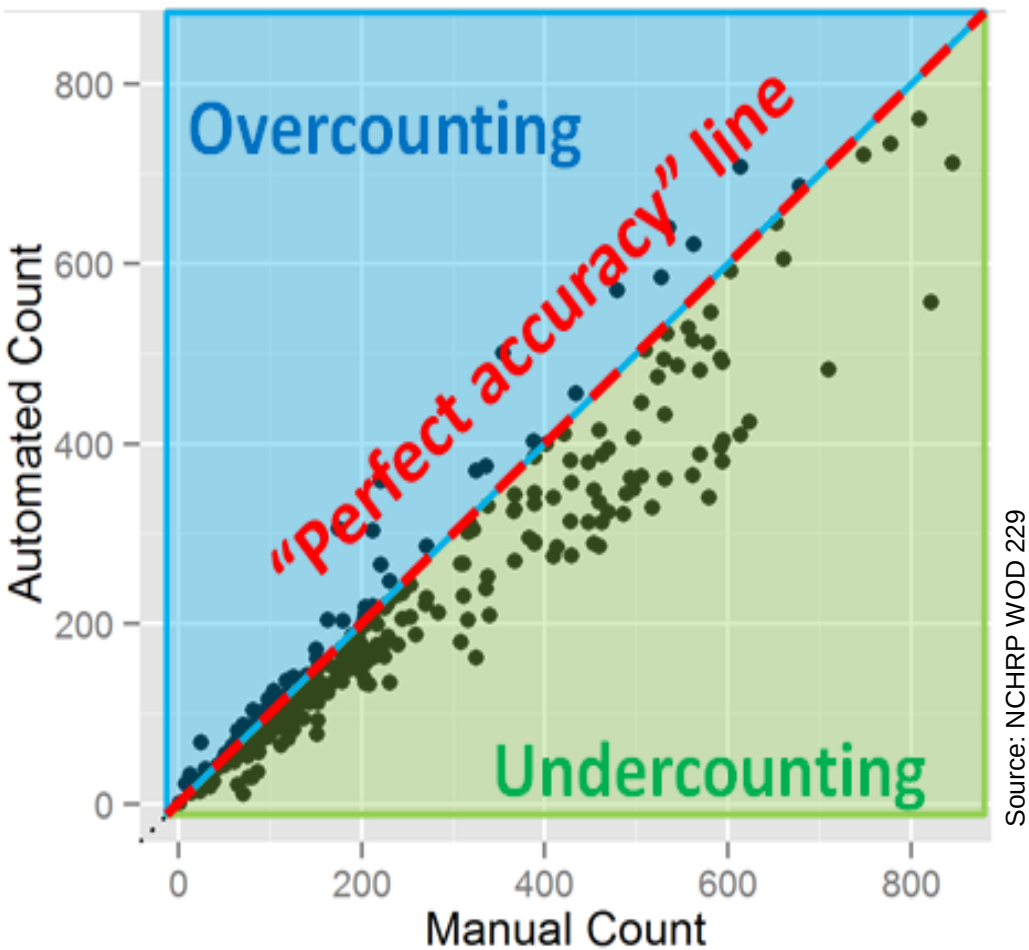
Bike Lane

Path

Intersection

Mixed Traffic

COUNTER ACCURACY



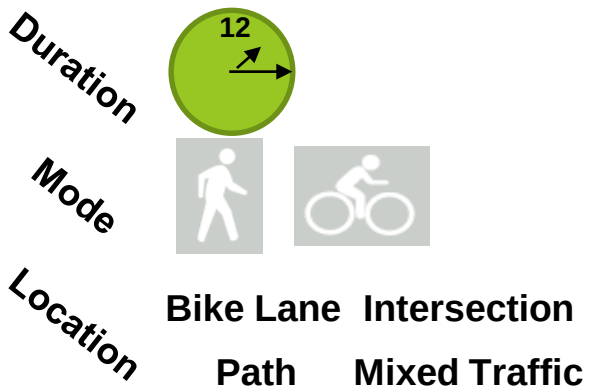
Source: NCHRP WOD 229

COUNT TECHNOLOGIES

MANUAL COUNTS

Photo Credit: Robert Schneider, UW Milwaukee

Volunteers and/or staff conduct counts in the field on clipboards or count boards/smartphones. Allows for collection of demographic data, turning movements.



Accuracy factors:

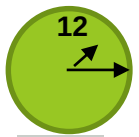
- Counter fatigue
- High volumes

MANUAL VIDEO COUNTS

Source: Frank Proulx

Video footage is taken in the field and later manually processed on a computer. Footage can often be processed faster than real time. Allows for collection of demographic data if footage is high quality. Highly flexible.

Duration



Mode

Location

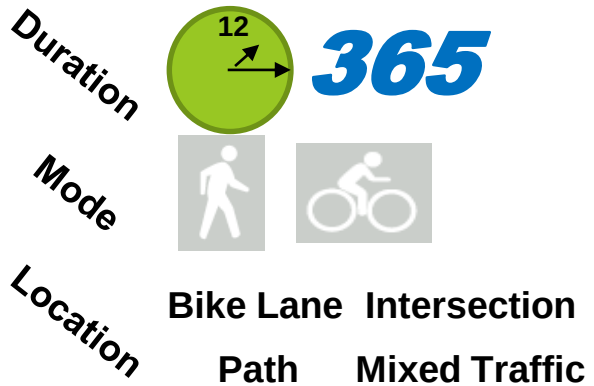
Bike Lane **Intersection**

Path **Mixed Traffic**

Presumed high accuracy

AUTOMATED VIDEO

Source: Miovision



Video footage is processed by a computer vision algorithm. Capability of conducting crossing and turning-movement counts.

Limited third party validation.

THERMAL IMAGING

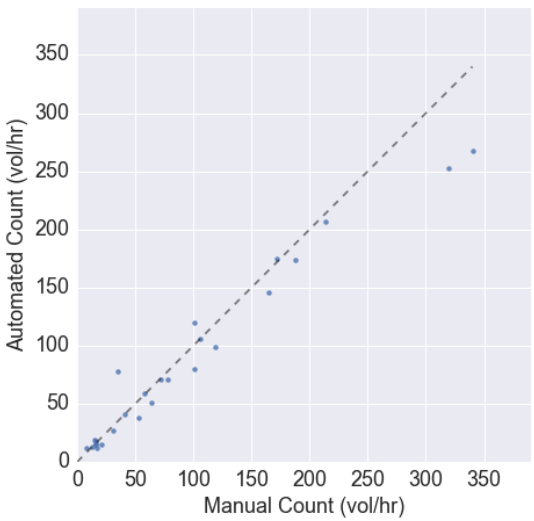
Source: FLIR Systems

Duration: 365

Mode:

Location: Bike Lane, Intersection, Path, Mixed Traffic

Computer vision algorithms are run on thermal camera to classify and count bicyclists and pedestrians. Thermal footage is used to count down on visual problems such as glare. Requires hardwiring.



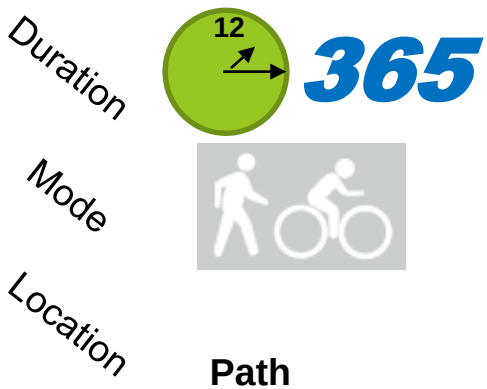
Source: NCHRP WOD 229

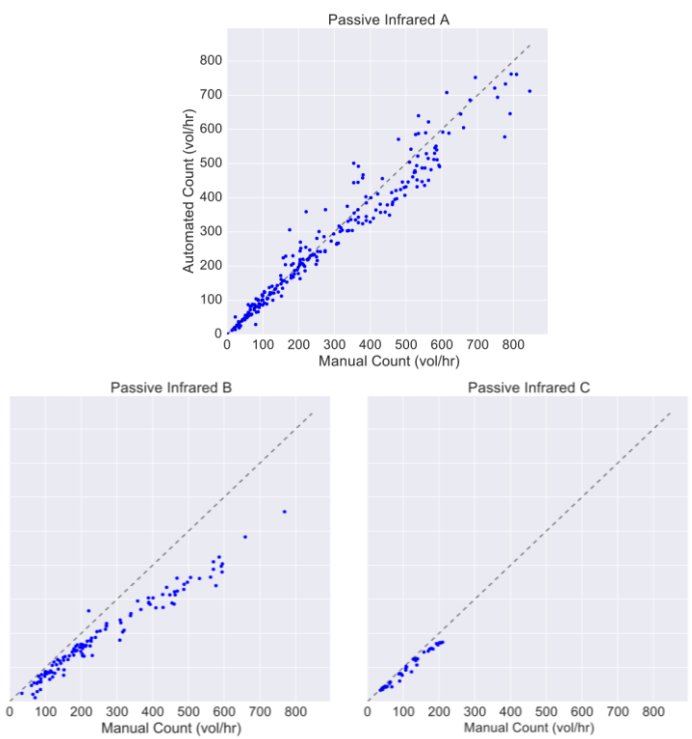
* Tested counting bicyclists in buffered bike lane.

PASSIVE INFRARED

Source: Frank Proulx

Detects people based on body heat profile. Does not distinguish bicyclists and pedestrians. Both portable and permanent units are available.



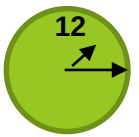


Source: NCHRP WOD 229

ACTIVE INFRARED

Source: Trailmaster

Duration



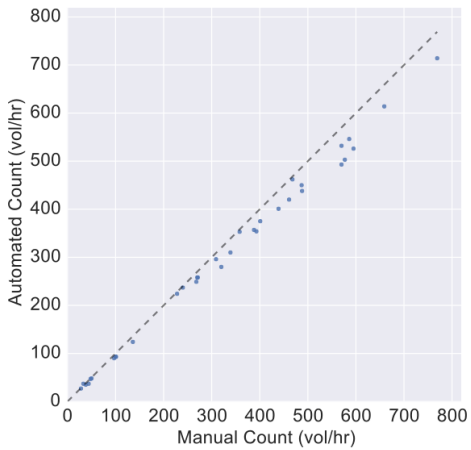
365

Mode

Location

Path

An infrared beam is created between a transmitter and a receiver. Counts are recorded whenever the beam is broken.



Source: NCHRP WOD 229

PRESSURE PADS

Source: Eco-Counter

Pressure-sensitive pads are installed under the trail surface. Pedestrians are counted when they step on the pad. This technology is primarily oriented at natural surface trails.

Duration 365

Mode

Location Path

Limited third-party testing.

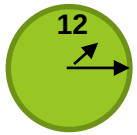
Count Technologies

RADAR

Source: NCHRP WOD 229

Source: Chambers Electronics

Duration



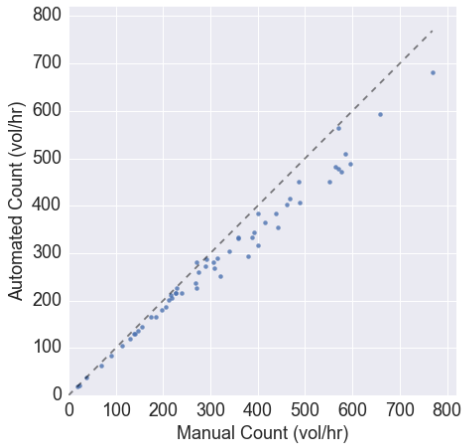
365

Mode

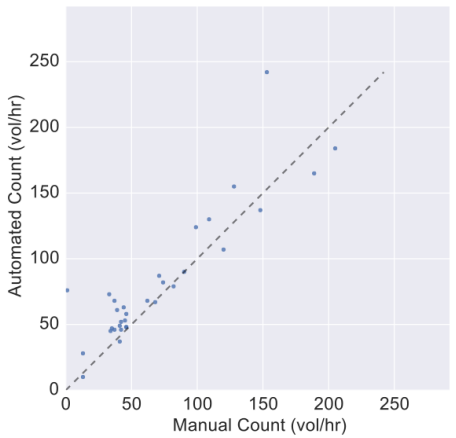
Location

Bike Lane

Path **Mixed Traffic**



* Single-sided lump-sum counter.



* In-ground sensor tested counting bicycles in a bicycle lane.

Source: NCHRP WOD 229

Transmitter/detector is installed in the pavement or in a freestanding unit. Emits radar pulses and classifies traffic based on the characteristics of reflected pulses.

INDUCTIVE LOOPS

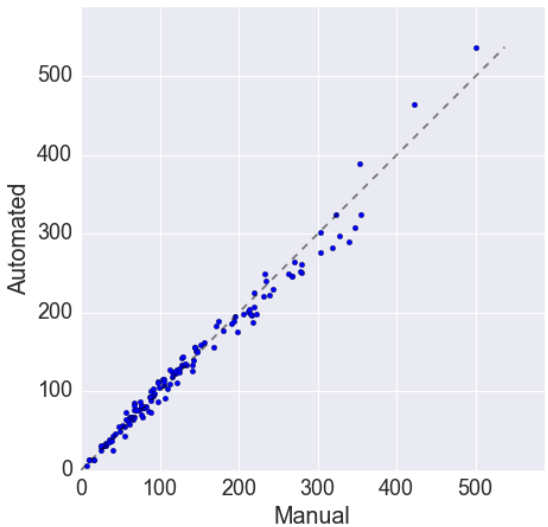
Source: Frank Proulx

A loop of wire is installed under the road or path with a current going through it, creating a magnetic field. When the magnetic field is disturbed by passing bicycles, the current is affected. Classification is based on the characteristics of the effects on the current. Subject to bypass errors.

Duration 365

Mode

Location Bike Lane Path Mixed Traffic

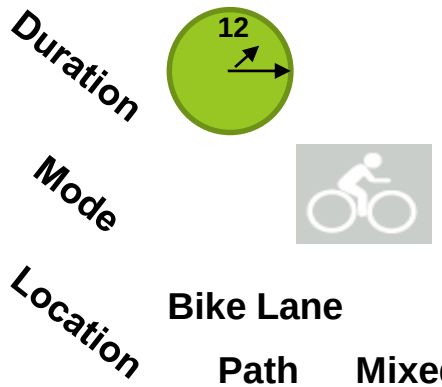


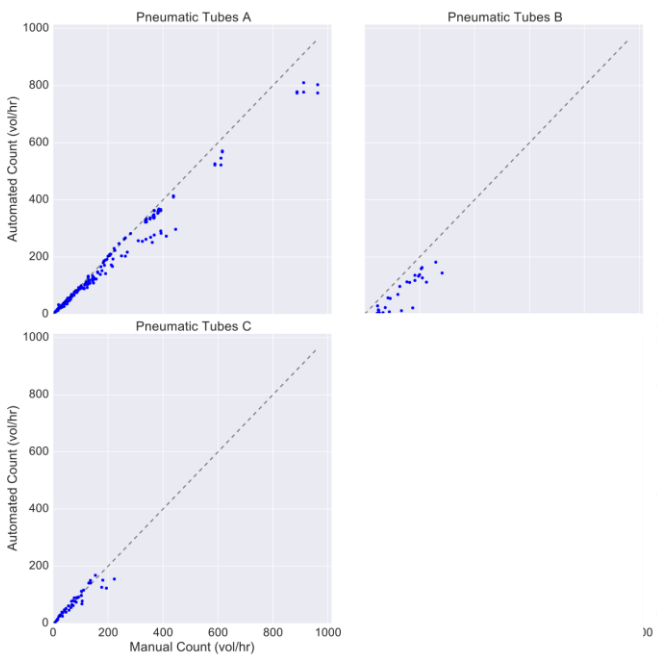
Source: NCHRP WOD 229

PNEUMATIC TUBES

Source: FHWA Traffic Monitoring Guide

Rubber tubes are bracketed or taped to the pavement. When a vehicle depresses the tubes, an air pulse is generated. Classification is carried out based on the speed and axle spacing observed with two tubes. Bicycles in mixed traffic can be counted during normal data collection. Bicycle-specific tubes should be used.





Source: NCHRP WOD 229

PIEZOELECTRIC STRIPS

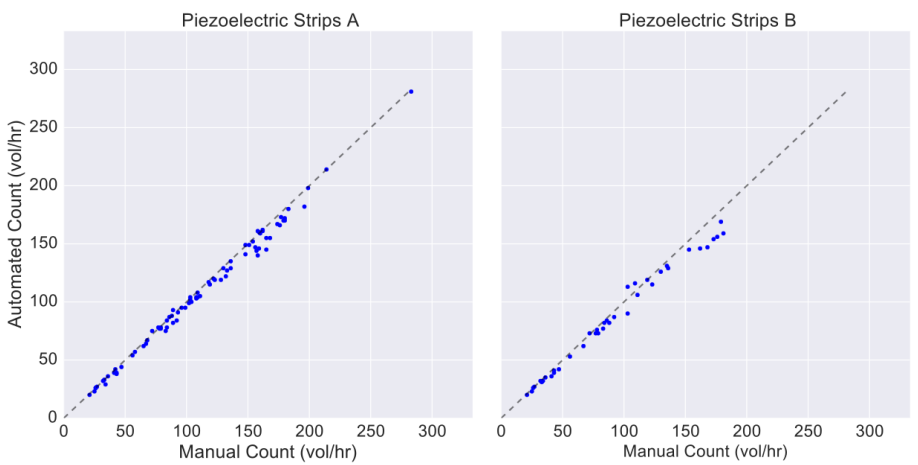
Source: metrocount.com

Duration **365**

Mode

Location **Bike Lane** **Path** **Mixed Traffic**

Two strips of piezoelectric material are installed under the road or path surface. When a vehicle passes over them, an electric signal is generated. Vehicle classification is performed based on speed and axle spacing from observing with two strips.



Source: NCHRP WOD 229

INFRARED + INDUCTIVE LOOPS

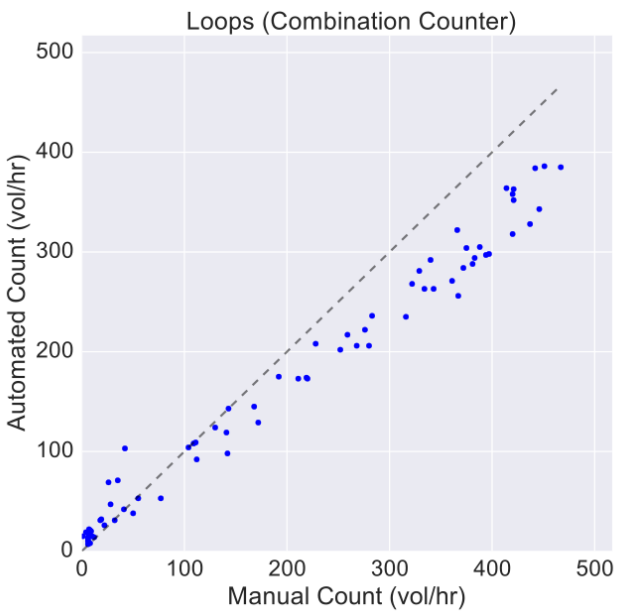
Source: Eco-Counter

Passive infrared sensor is used to count all non-motorized traffic. Inductive loops are used to count bicycles. Pedestrian volumes are inferred based on the difference.

Duration **365**

Mode

Location **Path**



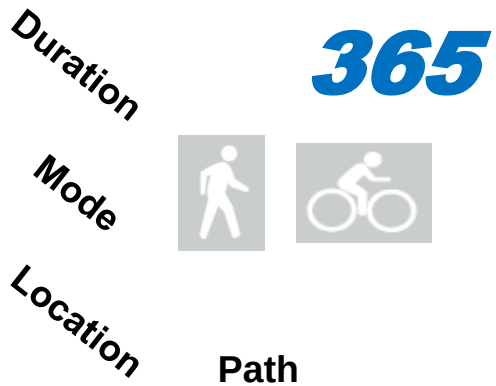
Source: NCHRP WOD 229

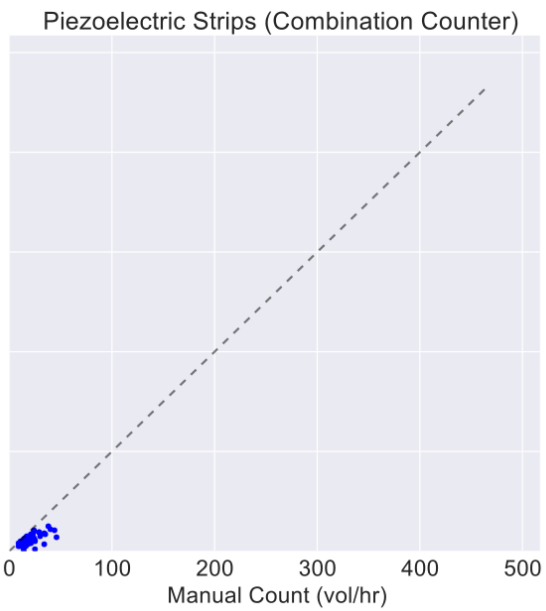
* Pedestrian volume estimates

INFRARED + PIEZOELECTRIC

Source: NCHRP WOD 229

Passive infrared sensor is used to count all non-motorized traffic. Piezoelectric strips are used to count bicycles. Pedestrian volumes are inferred based on the difference.



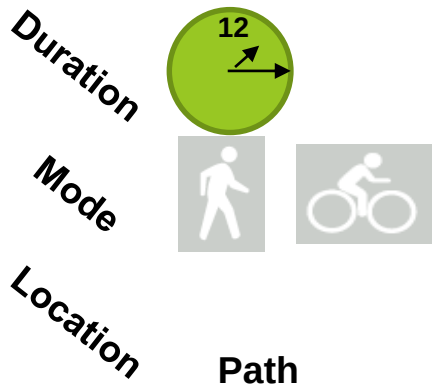


Source: NCHRP WOD 229

* Pedestrian volume estimates

INFRARED + PNEUMATIC TUBES

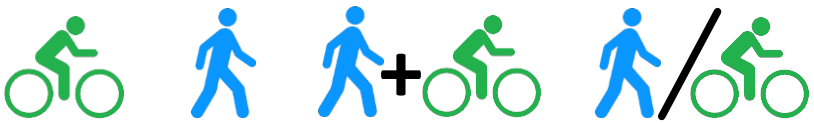
Source: NCHRP WOD 229



Passive infrared sensor is used to count all non-motorized traffic. Pneumatic tubes are used to count bicycles. Pedestrian volumes are inferred based on the difference.

TECHNOLOGY SELECTION

1. What Are You Counting?



	Technology	Bicyclists Only	Pedestrians Only	Pedestrians & Bicyclist Combined	Pedestrians & Bicyclist Separately	Cost
Permanent	Inductance Loops[1]	●			◐	$$
	Magnetometer[2]	○				$-$$
	Pressure Sensor[2]	○	○	○	○	$$
	Radar Sensor	○	○	○		$-$$
	Seismic Sensor	○	○	○		$$
2. How Long?	Video Imaging: Automated	○	○	○	○	$-$$
	Infrared Sensor (Active or Passive)	○[3]	●	●	◐	$-$$
	Pneumatic Tubes	●			◐	$-$$
	Video Imaging: Manual	○	○	○	●	$-$$$
Temporary/ Short Term	Manual Observers	●	●	●	●	$$-$$$

○ Indicates what is technologically possible.
● Indicates a common practice.
◐ Indicates a common practice, but must be combined with another technology to classify pedestrians and bicyclists separately.
$, $$, $$$: Indicates relative cost per data point.
[1] Typically requires a unique loop configuration separate from motor vehicle loops, especially in a traffic lane shared by bicyclists and motor vehicles.
[2] Permanent installation is typical for asphalt or concrete pavements; temporary installation is possible for unpaved, natural surface trails.
[3] Requires specific mounting configuration to avoid counting cars in main traffic lanes or counting pedestrians on the sidewalk.

Source: Traffic Monitoring Guide, pg. 4-4

REMAINING CHALLENGES

- Continuous pedestrian crossing counts
- Continuous bicycle turning-movement counts
- Bypass errors for on-street bicycle counts

… AND REMEMBER!

Follow installation instructions

Calibrate your devices

Perform validation counts

Thanks!

Frank Proulx, Ph.D.
frankproulx@altaplanning.com

Getting Quality Data

Make Sure You Validate That!

SARAH O'BRIEN
Bicycle and Pedestrian Program
Institute for Transportation Research and Education

PBIC Webinar
Feb. 23, 2017

ITRE NC STATE UNIVERSITY

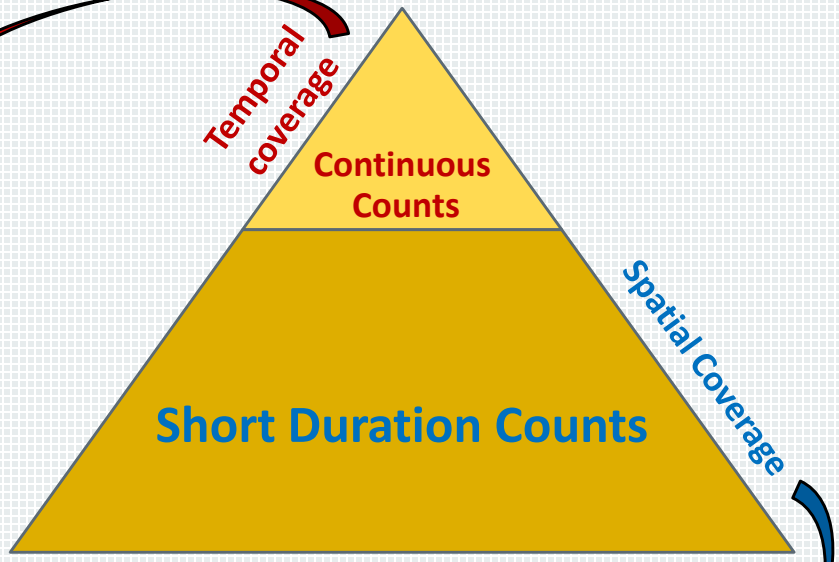
Research Project

Establish a common, consistent system to quantifiably measure bicycle and pedestrian volumes.

Non-Motorized Volume Data Program

What gets measured, gets done.
If you're not counted, you don't count!

ITRE



Continuous Count Stations *– Permanent counting sites that provide data continuously (24 hours per day, 7 days per week).*

Annual Average Daily Pedestrian Traffic (AADP)	Annual Average Daily Bicycle Traffic (AADB)

Enough data should be collected to allow calculation of accurate adjustment factors (Time of Day, Day of Week, Monthly) to apply to ***Short Duration Counts****.*

ITRE

NC STATE UNIVERSITY

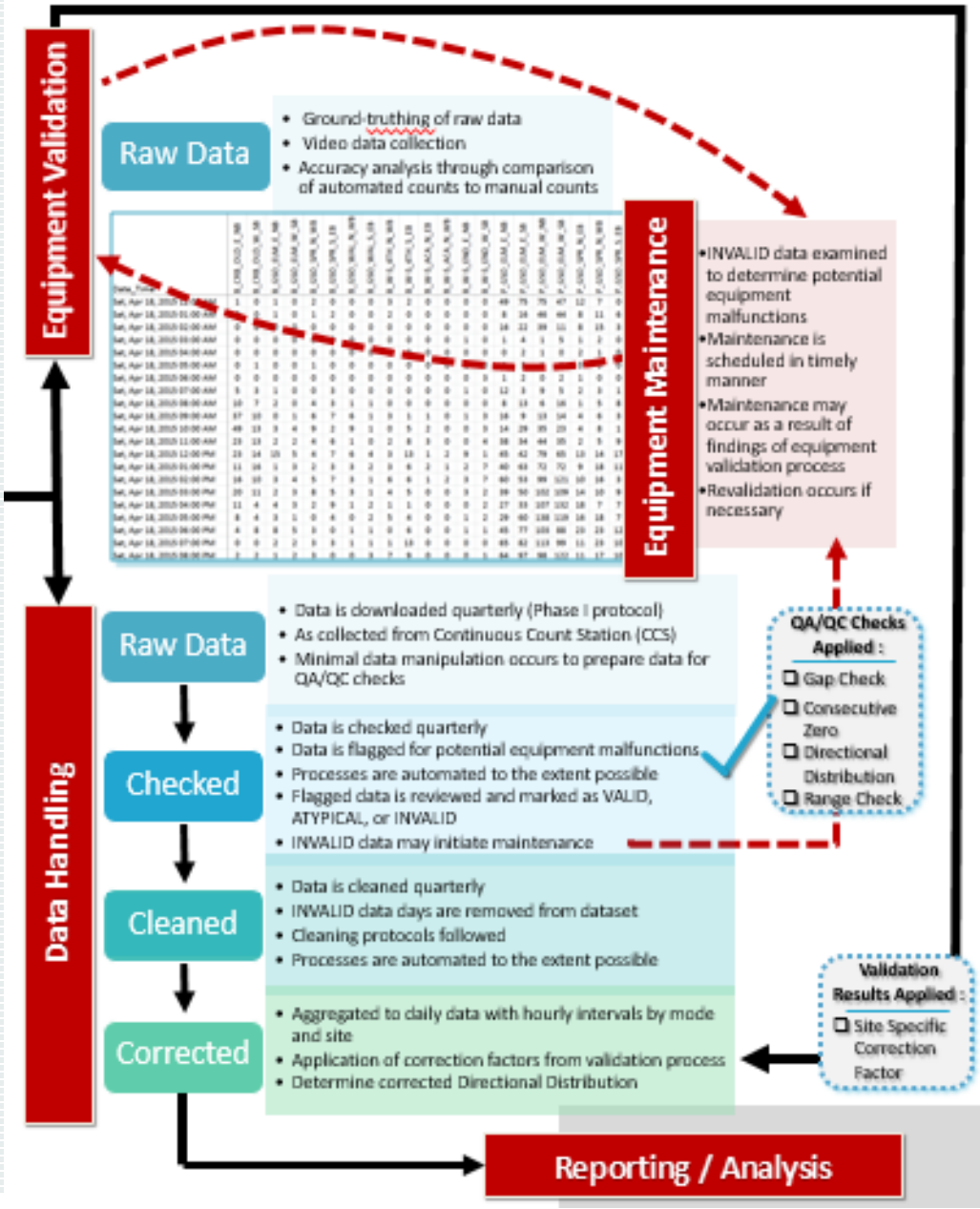
Accuracy of the data collected by CCSs are critical for credibility of the program and usefulness of the data.

ITRE

NC STA

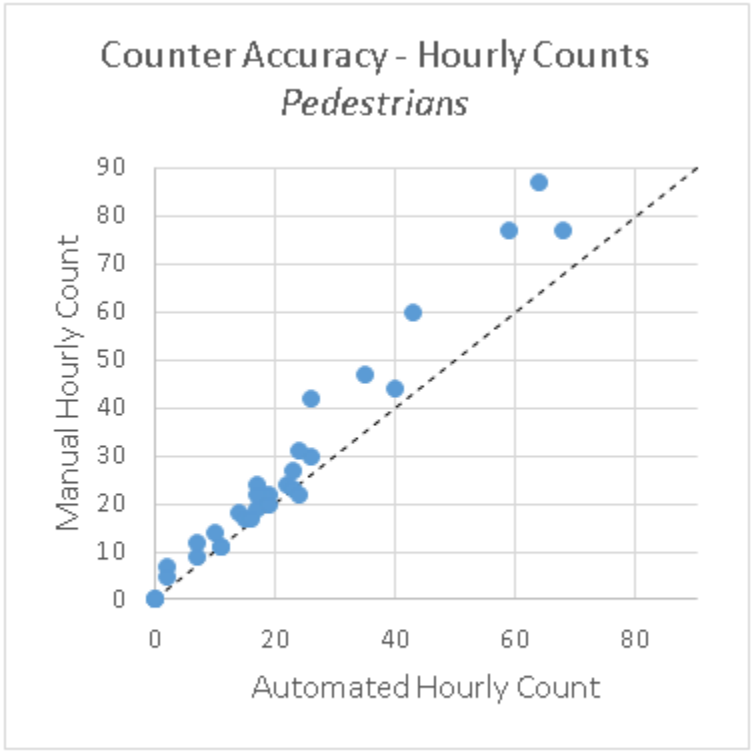
NON-MOTORIZED TRAFFIC MONITORING PROGRAM ELEMENTS

CCS Data

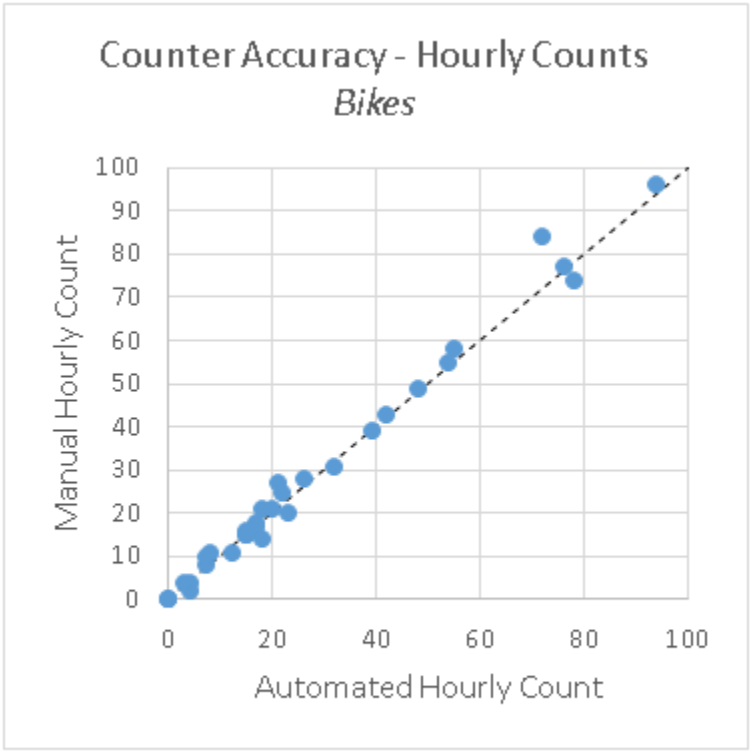

Equipment Validation
Raw Data
• Ground-truthing of raw data
• Video data collection
• Accuracy analysis through comparison of automated counts to manual counts
Equipment Maintenance
•INVALID data examined to determine potential equipment malfunctions
•Maintenance is scheduled in timely manner
•Maintenance may occur as a result of findings of equipment validation process
•Revalidation occurs if necessary
Data Handling
Raw Data
• Data is downloaded quarterly (Phase I protocol)
• As collected from Continuous Count Station (CCS)
• Minimal data manipulation occurs to prepare data for QA/QC checks
QA/QC Checks Applied :
❑ Gap Check
❑ Consecutive Zero
❑ Directional Distribution
❑ Range Check
Checked
• Data is checked quarterly
• Data is flagged for potential equipment malfunctions
• Processes are automated to the extent possible
• Flagged data is reviewed and marked as VALID, ATYPICAL, or INVALID
• INVALID data may initiate maintenance
Cleaned
• Data is cleaned quarterly
• INVALID data days are removed from dataset
• Cleaning protocols followed
• Processes are automated to the extent possible
Corrected
• Aggregated to daily data with hourly intervals by mode and site
• Application of correction factors from validation process
• Determine corrected Directional Distribution
Validation Results Applied :
❑ Site Specific Correction Factor
Reporting / Analysis

Validation Study – What is It?

- Comparing manual counts to automated counts to get an error rate and analyze for accuracy – Testing the accuracy and precision of the equipment



Pedestrian Validation Dates:
09/05/15 06:00-22:00, 09/03/15 06:00-22:00



Bike Validation Dates:
09/05/15 06:00-22:00, 09/03/15 06:00-22:00

Validation Study – What Is It?

Accuracy Metric	What it Measures
Average Percentage Deviation (APD)	Overall Divergence from Truth
Average of the Absolute Percent Difference (AAPD)	Consistency in Error
Pearson's Correlation Coefficient (r)	Linear correlation

$$\text{Error Rate} = \frac{\text{Manual Counts}}{\text{Automated Counts}}$$

Rate >1, undercounting machine
Rate <1, overcounting machine

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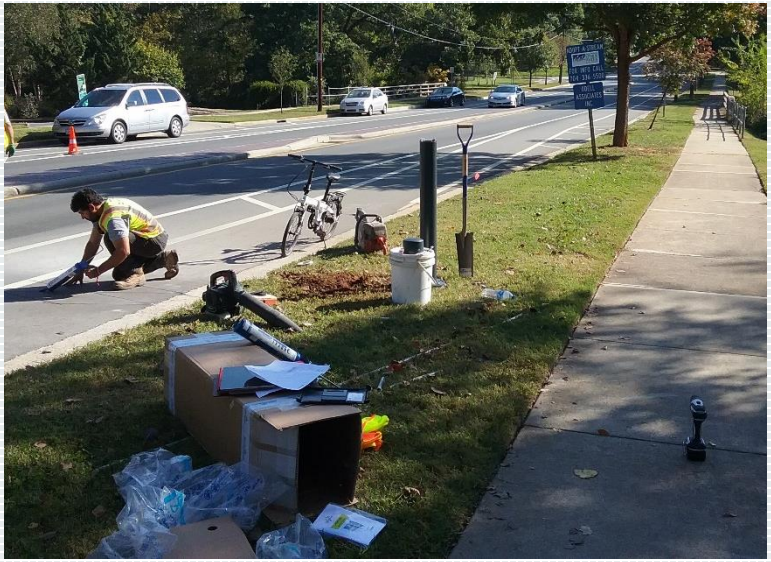
Validation Study – When to Do It?

Best Practice: Annually



At new station installation

Maintenance Trigger

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Validation Study – How to Do It

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Validation Study – How to Do It

- 30 time periods (NCHRP 797)
  - 15-min interval = 8 hours ground truth
  - 60-min interval = 30 hours ground truth
  - Mix of volume ranges
- ~ 24-28 hours (NCNMVDP)
  - 15-min intervals, aggregated to hourly
  - Need people to be counted!

Validation Data

				NB		SB		Total		
Date	DOW	Begin Time	End	Manual	Eco	Manual	Eco	Manual	Eco	Difference
10/14/2015	Wed	6:00	6:15							
10/14/2015	Wed	6:15	6:30							
10/14/2015	Wed	6:30	6:45							
10/14/2015	Wed	6:45	7:00							
10/14/2015	Wed	7:00	7:15	2	2	0	0	2	2	0
10/14/2015	Wed	7:15	7:30	0	0	0	0	0	0	0
10/14/2015	Wed	7:30	7:45	2	1	3	2	5	3	2
10/14/2015	Wed	7:45	8:00	1	1	1	1	2	2	0
10/14/2015	Wed	8:00	8:15	0	0	0	0	0	0	0
10/14/2015	Wed	8:15	8:30	3	1	0	0	3	1	2
10/14/2015	Wed	8:30	8:45	3	1	2	0	5	1	4
10/14/2015	Wed	8:45	9:00	0	0	0	4	0	4	-4
10/14/2015	Wed	9:00	9:15	0	7	1	8	1	15	-14
10/14/2015	Wed	9:15	9:30	2	3	2	1	4	4	0
10/14/2015	Wed	9:30	9:45	1	2	2	3	3	5	-2
10/14/2015	Wed	9:45	10:00	5	6	1	2	6	8	-2
10/14/2015	Wed	10:00	10:15	0	0	10	5	10	5	5
10/14/2015	Wed	10:15	10:30	5	3	1	3	6	6	0
10/14/2015	Wed	10:30	10:45	1	4	1	4	2	8	-6
10/14/2015	Wed	10:45	11:00	0	0	6	5	6	5	1
10/14/2015	Wed	11:00	11:15	6	2	1	2	7	4	3

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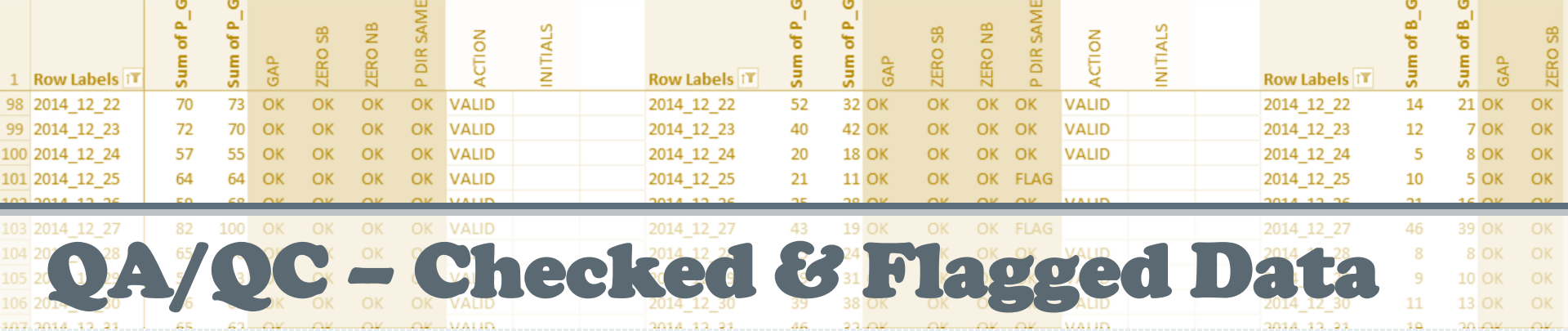


1	Row Labels	Sum of P_G	Sum of P_G	GAP	ZERO SB	ZERO NB	P DIR SAME	ACTION	INITIALS
98	2014_12_22	70	73	OK	OK	OK	OK	VALID	
99	2014_12_23	72	70	OK	OK	OK	OK	VALID	
100	2014_12_24	57	55	OK	OK	OK	OK	VALID	
101	2014_12_25	64	64	OK	OK	OK	OK	VALID	
103	2014_12_27	82	100	OK	OK	OK	OK	VALID	

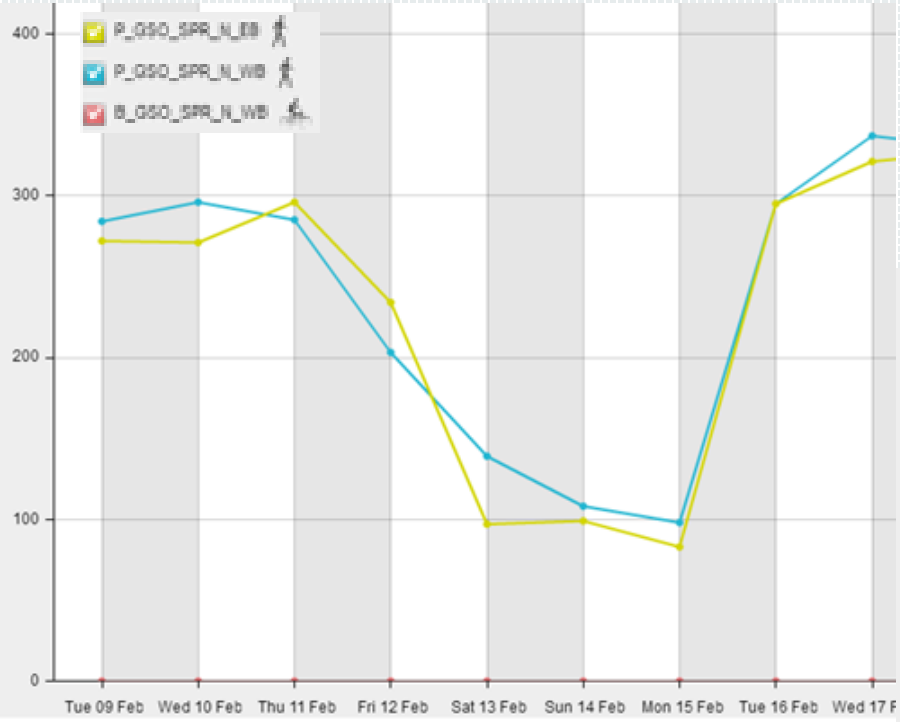
Row Labels	Sum of P_G	Sum of P_G	GAP	ZERO SB	ZERO NB	P DIR SAME	ACTION	INITIALS
2014_12_22	52	32	OK	OK	OK	OK	VALID	
2014_12_23	40	42	OK	OK	OK	OK	VALID	
2014_12_24	20	18	OK	OK	OK	OK	VALID	
2014_12_25	21	11	OK	OK	OK	FLAG		
2014_12_27	43	19	OK	OK	OK	FLAG		

Row Labels	Sum of B_G	Sum of B_G	GAP	ZERO SB
2014_12_22	14	21	OK	OK
2014_12_23	12	7	OK	OK
2014_12_24	5	8	OK	OK
2014_12_25	10	5	OK	OK
2014_12_27	46	39	OK	OK

QA/QC – Checked & Flagged Data

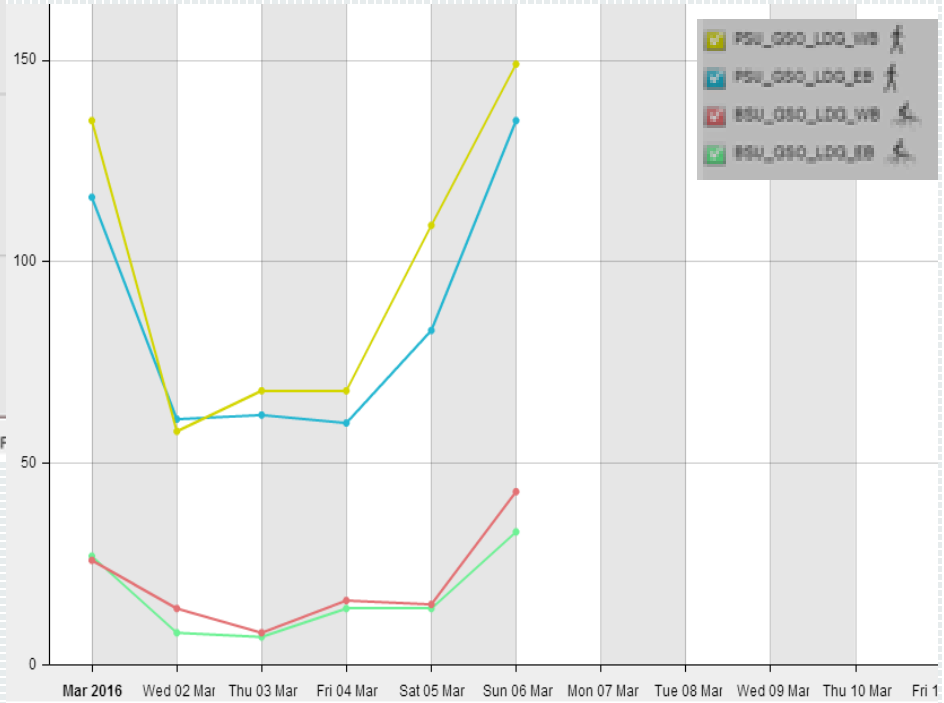
- Valid (not flagged)
- Invalid
  - No data
  - Unexplained unusually high or low volumes
  - Unexplained skewed directional distribution
- Atypical
  - Explainable unusually high or low volumes
  - E.g. Special events, races, holiday, extreme weather event

Invalid Data / Suspicious Data = Maintenance Troubleshooting



Faulty Sensor?

Transmission Error



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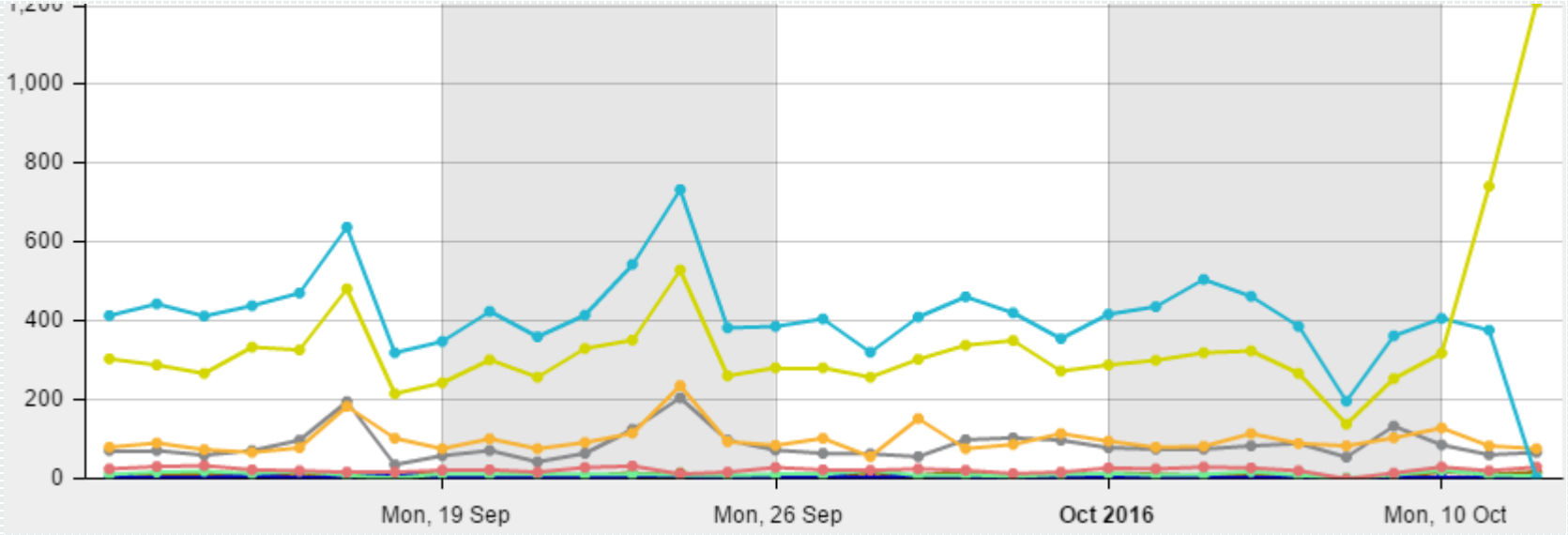
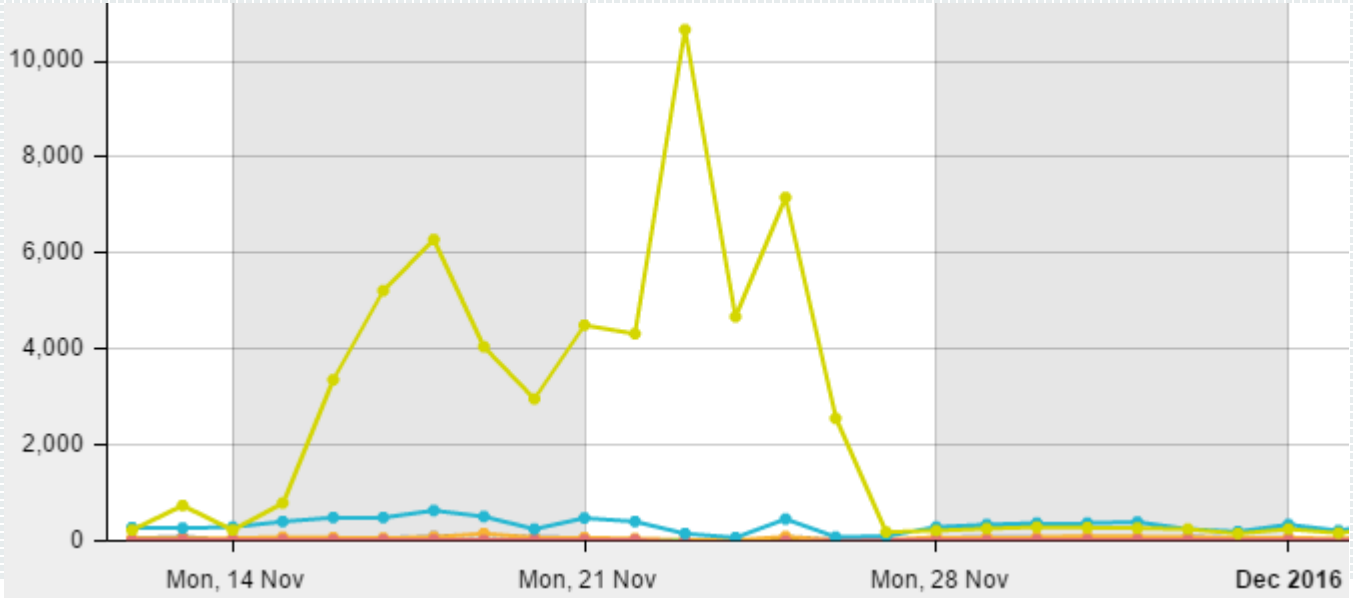
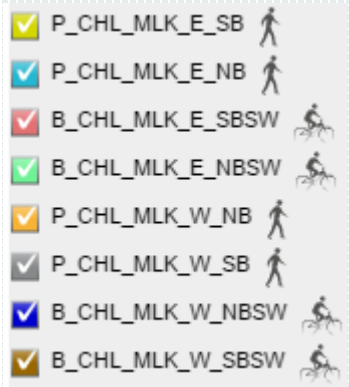


Normal Pattern (above) vs. Abnormal Pattern (below)





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Maintenance = Re-Validation

- New correction factor calculated to be applied to “new normal” for data collected since maintenance intervention
- When is it triggered?
  - Changing a sensor part (YES)
  - Clearing an obstructed sensor (NO)
  - Changing settings/functionality of counter (YES)
  - Changing battery (NO)

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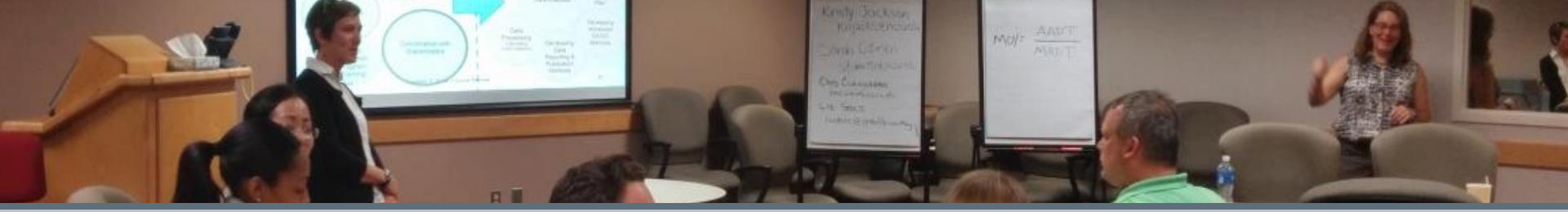

Thank You!

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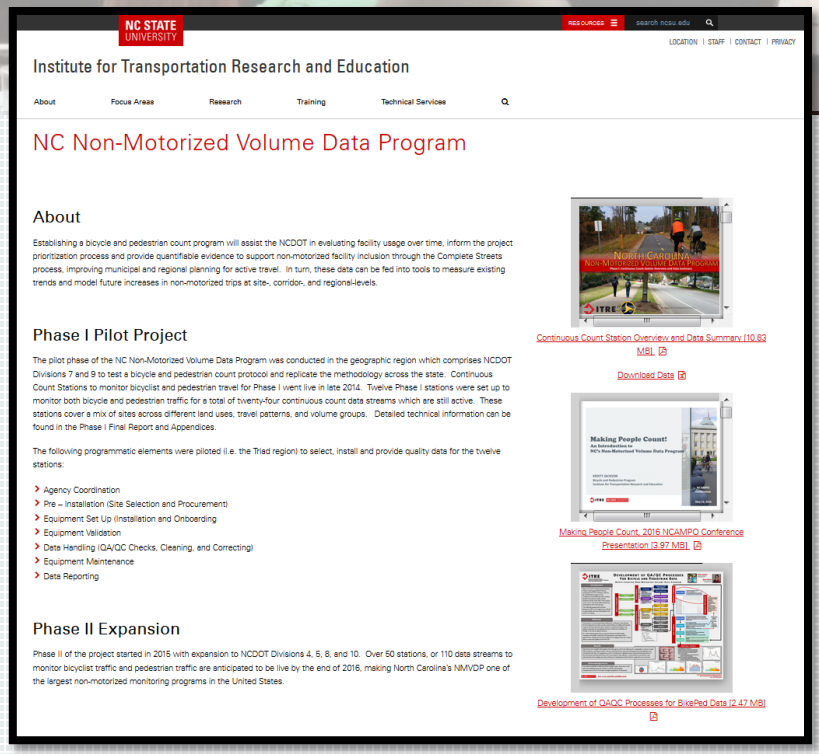

itre.ncsu.edu/focus/bike-ped/nc-nmvdp/

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Questions?

- **Archive at www.pedbikeinfo.org/webinars**
  Download a video recording and presentation slides
- **Questions?**
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  - **Frank Proulx frankproulx@altaplanning.com**
  - **Sarah O'Brien skworth@ncsu.edu**
  - **General Inquiries pbic@pedbikeinfo.org**