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**Monitoring  
Usage of  
Active  
Transportation  
Facilities**

# Background

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# Why Count?

## Data driven decision making

- Public education and promotion
- Infrastructure justification
- Infrastructure planning and design
- Infrastructure evaluation
- Transportation demand management
- Safety evaluation

# IMP Actions

- *Action 85: Obtain baseline data of pedestrian volumes and bicycle use, including counts at strategic location.*
- *Action 86: Update data periodically and correlate with infrastructure improvements to help determine their effectiveness.*

# Traffic Monitoring Equipment (TME)

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# Automated Video

Bell Camera with processor  
(Gridsmart)



Scout VCU  
(Miovision)



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# TME



Pneumatic Tubes  
(Eco-Counter)

## Passive Infrared (TrafX)



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# TME



Magnetometer  
(TrafX)

## Inductive Loops (Eco-Counter)





# Manual Counts

Location: Station #1 Pryor

Date: \_\_\_\_\_

Weather / Temperature: \_\_\_\_\_

Time (from -to): \_\_\_\_\_

Name: \_\_\_\_\_

M = Male  
F = Female  
U = Uncertain

			- 15 min					- 30 min						
			# of cyclists	No helmet	Cycle on sidewalk	Cycle on crosswalk	Other illegal moves*	# of cyclists	No helmet	Cycle on sidewalk	Cycle on crosswalk	Other illegal moves*		
PRYOR	Adult (18-65 years)	M												
		F												
		U												
	Child/Youth (<18 years)	Own Bike	M											
			F											
			U											
		Child Seat/ Trailer	M											
			F											
			U											
	Senior (> 65 years)	M												
		F												
		U												
TOTAL														



\* Other illegal moves: (a) running or "jumping" red light or stop sign; (b) wrong way - one way street; (c) riding side by side; (d) ignoring turn restrictions; (e) jumping curbs; (f) turning from the wrong lane

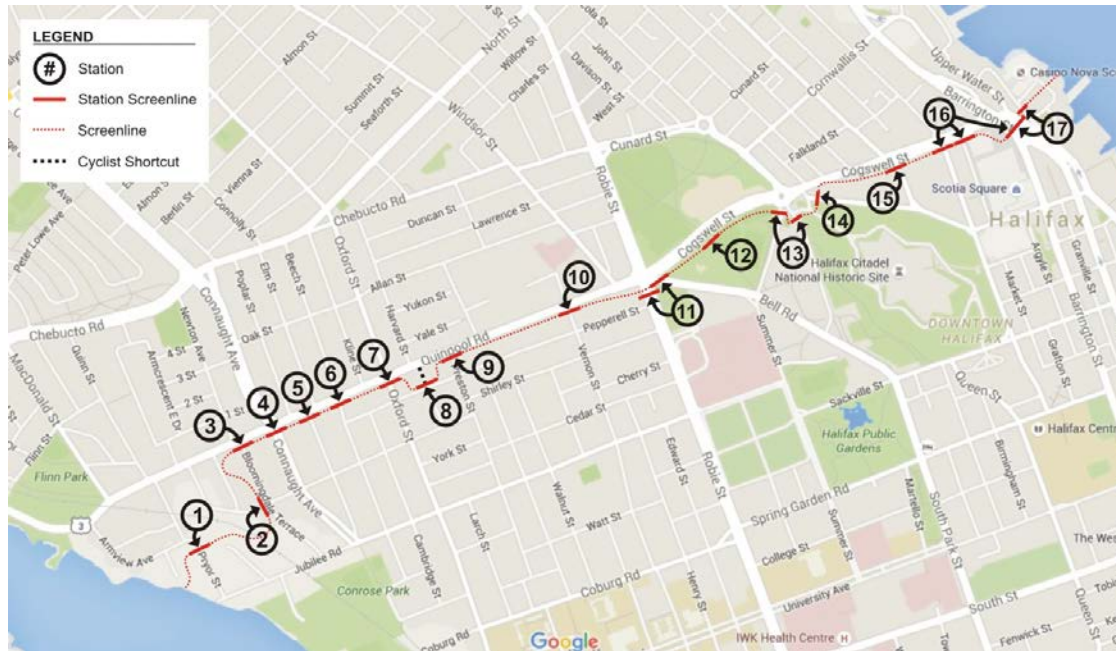
Notes: Riding on the road when a bike lane is present is legal, and so is "taking the lane" if there is a reason to do so; count tandems with two cyclists as two; count children in bike trailers or on "tag along" bikes as cyclists on the top line but note them in the "own bike" or "trailer" line. Helmets that are not fastened properly or that are not proper bike helmets count as "no helmet". Note if you see any hazards such as potholes, left cross, right hook, etc.

# Current Efforts

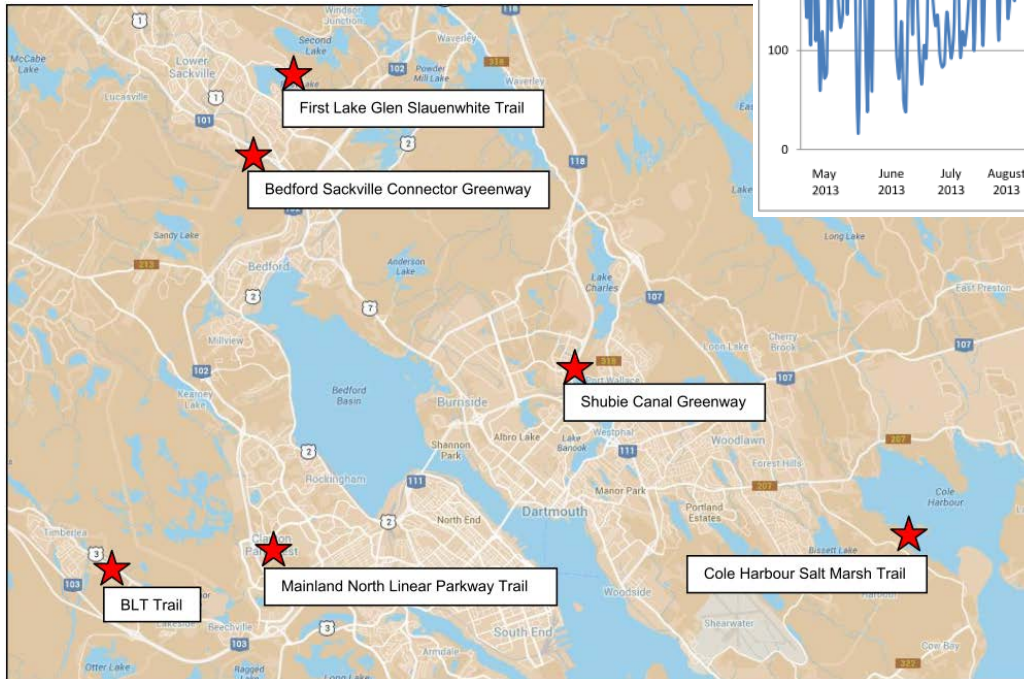
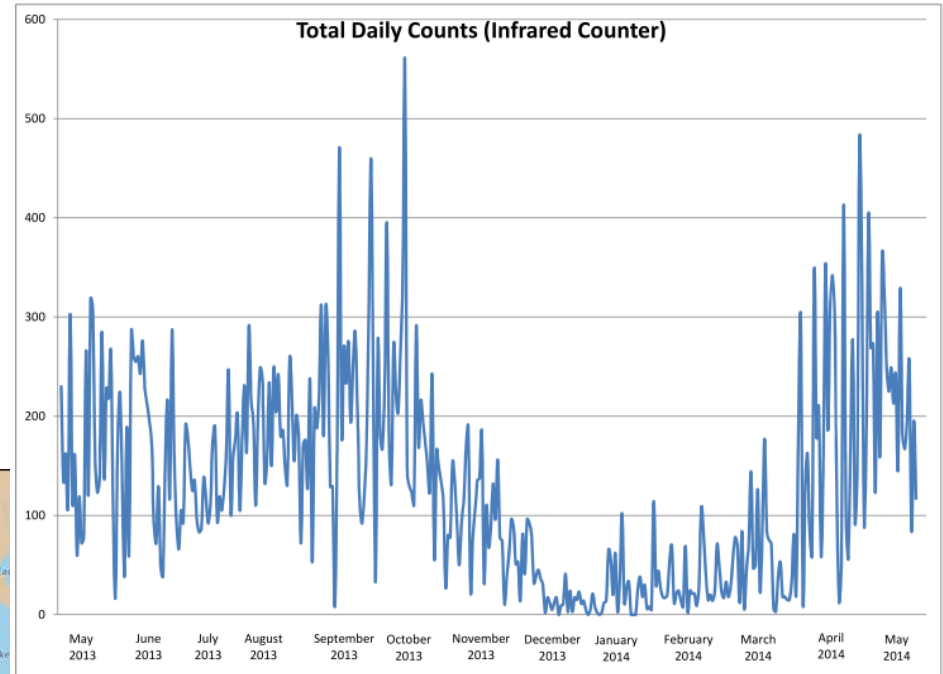
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# Peninsula Screenline

- 22 counts biannually since 2010
- Peak hour counts: 7-9am & 4-6pm
- Mixture of manual collection and time lapse cameras

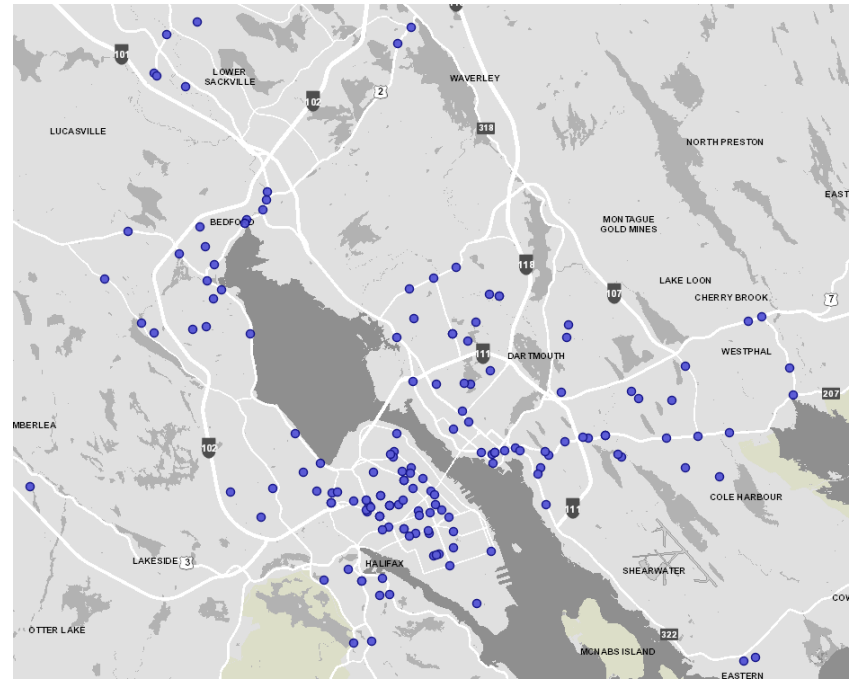


# Trail Counts



# Turning Movement Counts

- Can be video or manual
- 4 to 24 hours
- 7-9am, 11am-1pm, and 4-6pm
- 200-300 per year



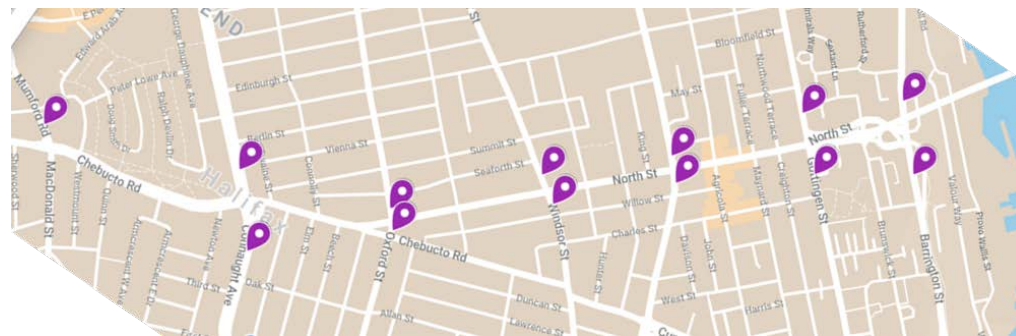
2018 TMC's

With software assistance we can now collect cyclist and pedestrian data at all manual TMC's.

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# Traffic Volume Screenline

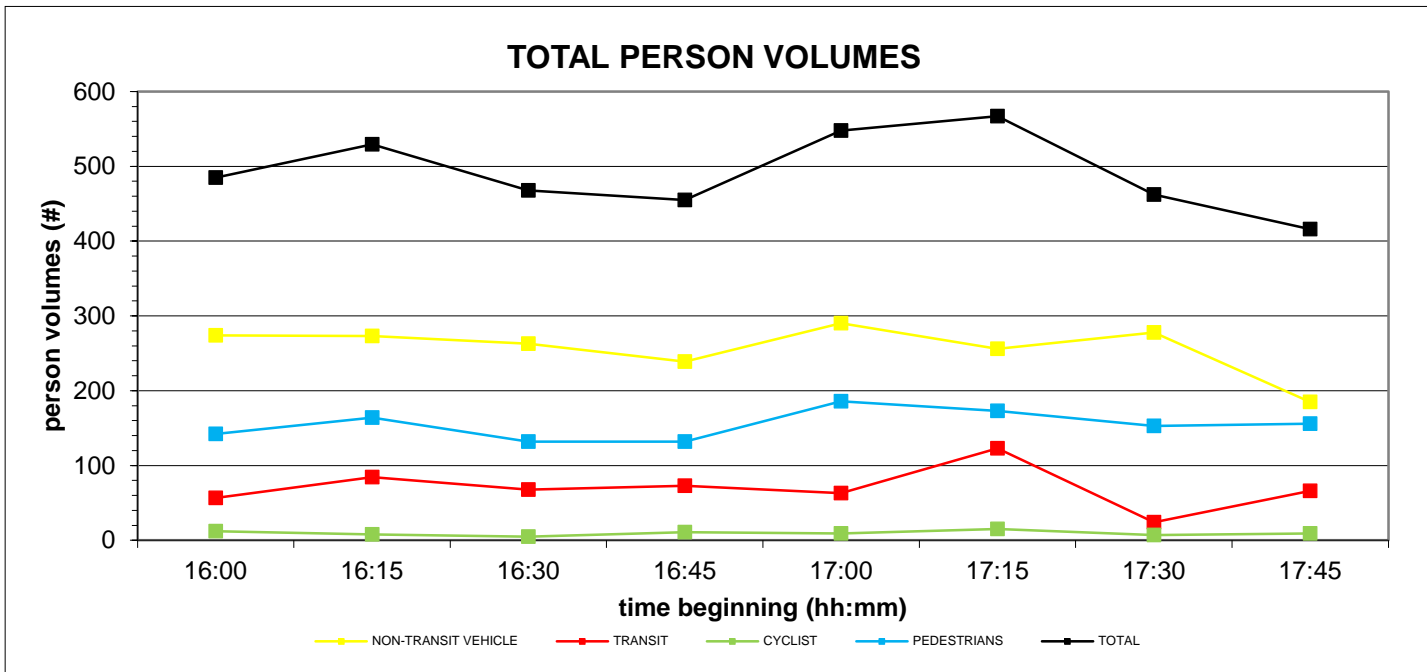
- Annual 24 hour vehicle volume studies
- Taken at ~40 locations on 6 screenlines
- Identified 13 strategic locations to capture bicycle and vehicle data simultaneously



North-Chebucto Screenline

# Multimodal Occupancy Count

- Determine the modal distribution of people throughput on a cross-section of a given corridor.
- Great data but staff intensive



South Park St

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# Project Specific Counts

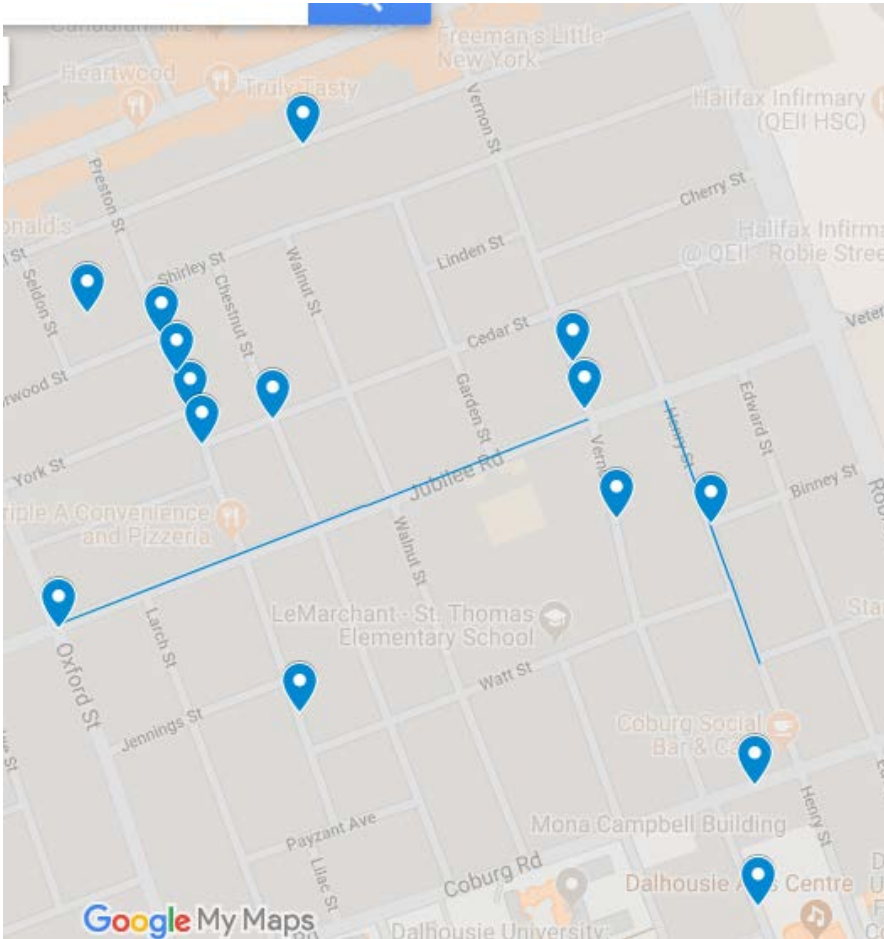
**Scheduled on as needed basis:** May be done in advance of or during a planning project with no follow up

**Highly targeted location:** Generally done on the site of proposed facilities or areas of interest

**Inconsistent Methodologies:** Counts are taken with very specific project goals in mind making intra and inter count comparison problematic



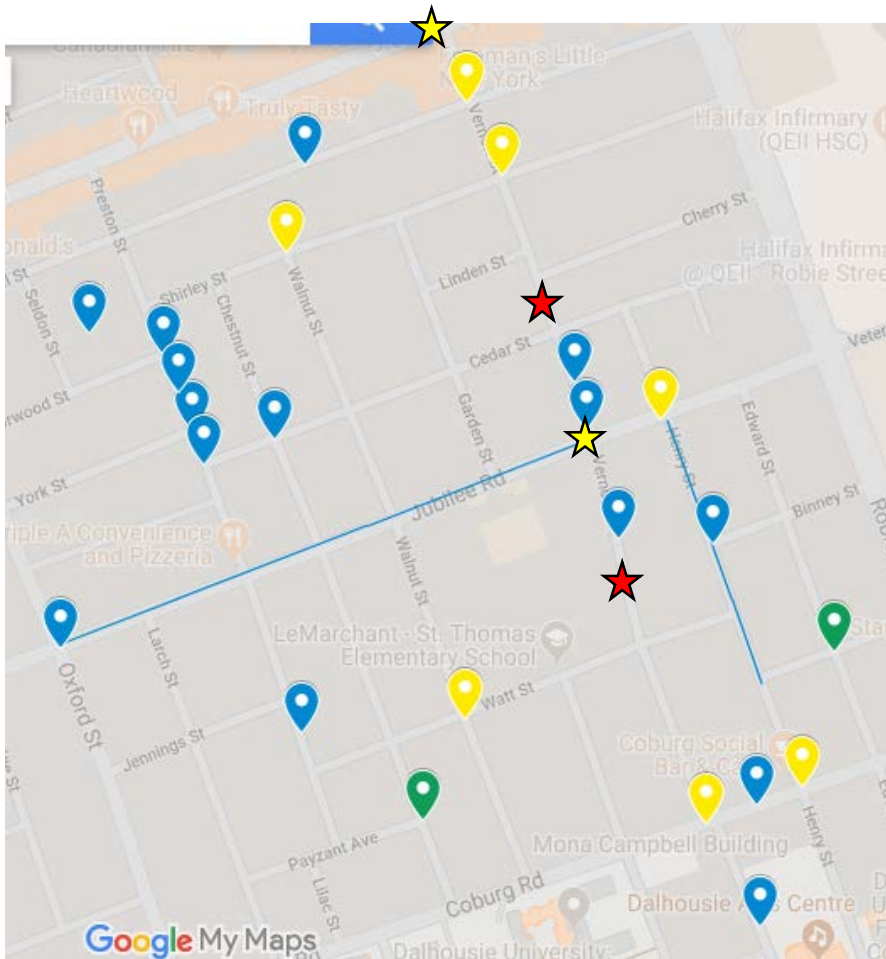
# Vernon Local Street Bikeway



Traffic calming and diversion measures implemented on a residential corridor

- Inventory existing data
- Identify key metrics
  - Speed at bump-outs
  - Compliance at turn restrictions

# Vernon Local Street Bikeway



- Fill in gaps in data to establish robust baseline
- Follow up on key metrics on a 3/6/12 month schedule.
- Evaluate facility based on performance

# Strategy

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# General Strategies

## **Standardize Methodology**

Conformity in count type and length increases precision and accuracy

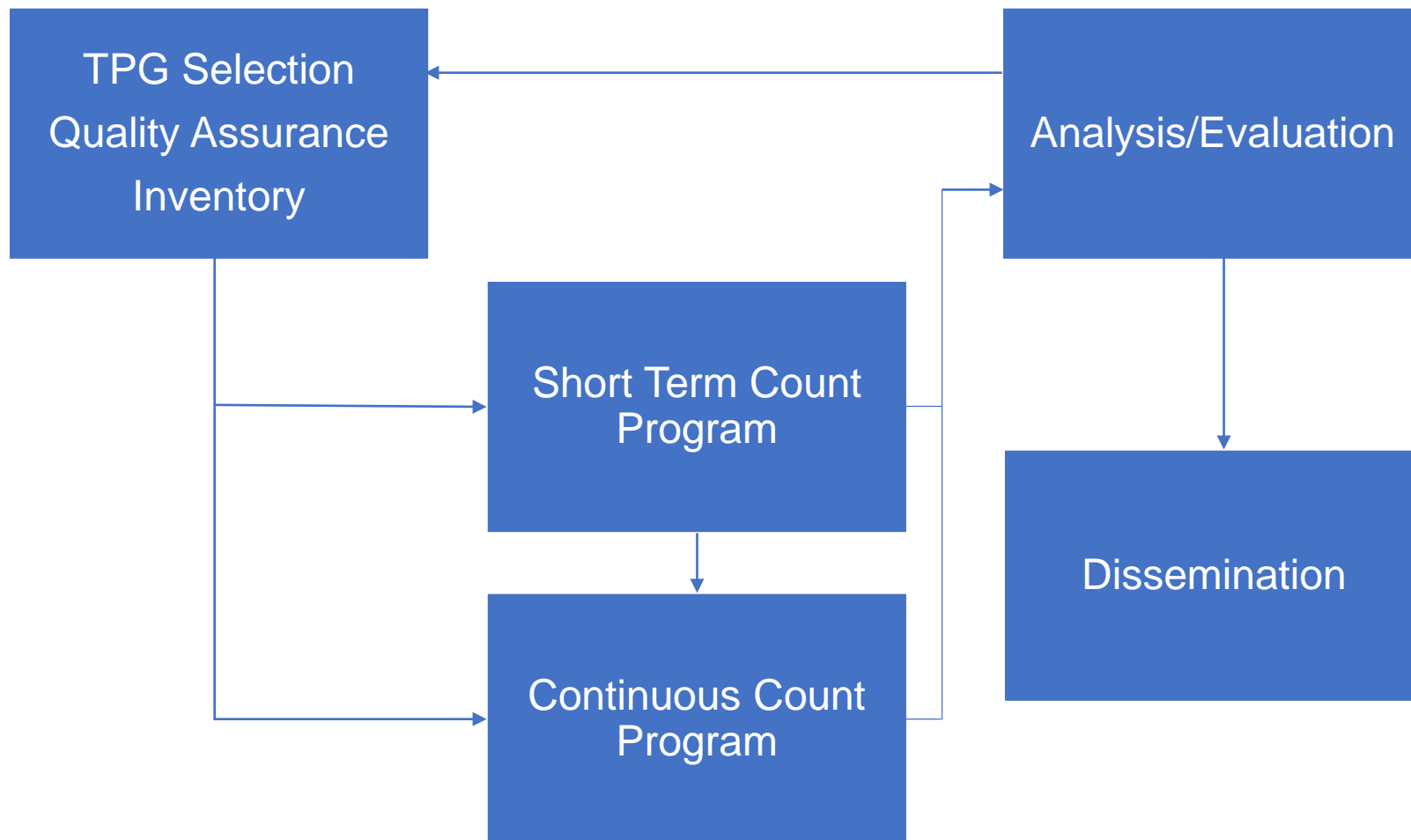
## **Achieve System Wide Coverage**

Well defined geographic and network constraints creates baseline for systemic approach

## **Normalize and Contextualize Data**

Factoring data increases utility and allows for meaningful dissemination

# Process Framework



# Inventory

## **Resources**

- Traffic Monitoring Equipment (TME)
- Staffing Resources

## **Existing Data Sources**

- Internal and External

## **Ongoing Collection Programs**

- Internal and External

# Traffic Pattern Groups (TPGs)

Sets of temporal usage patterns used to group count sites.

Three approaches to development

**Traditional**

- Group using qualitative characteristics

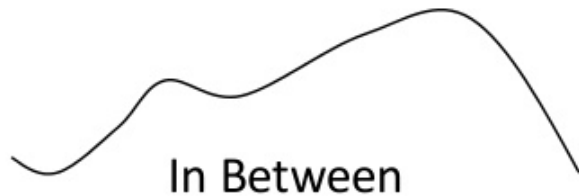
**Cluster**

- Group using statistical procedures

**Hybrid**

- Combination of statistical procedures and professional judgement

# TPG Starting Point



- Identifiable through visual analysis
- Requires a level of professional judgement
- More patterns increase accuracy
  - Time of day
  - Day of week
  - Seasonal



# Continuous Counts

Sites with permanent TME installation provide 24/7 year round data on temporal variation of network usage.

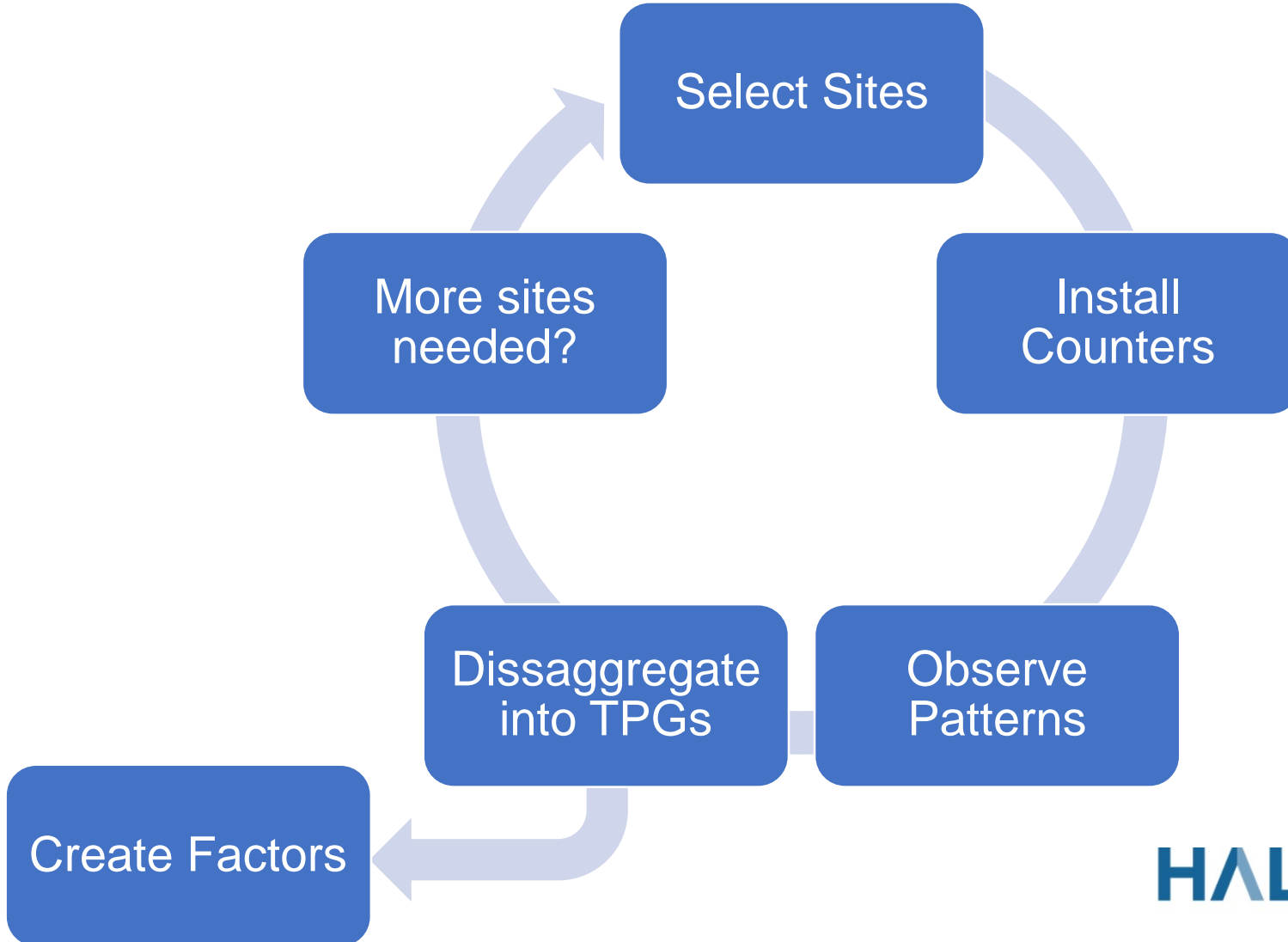
## Representative Locations

- TPGs can be estimated based on facility type, geographical area and land use.
- Distribute sites evenly among TPGs.
- Minimum 2 sites per TPG. 3-5 is ideal.

## Targeted Locations

- Prioritize sites with high visibility, high volumes and untested facility types.

# Continuous Counts

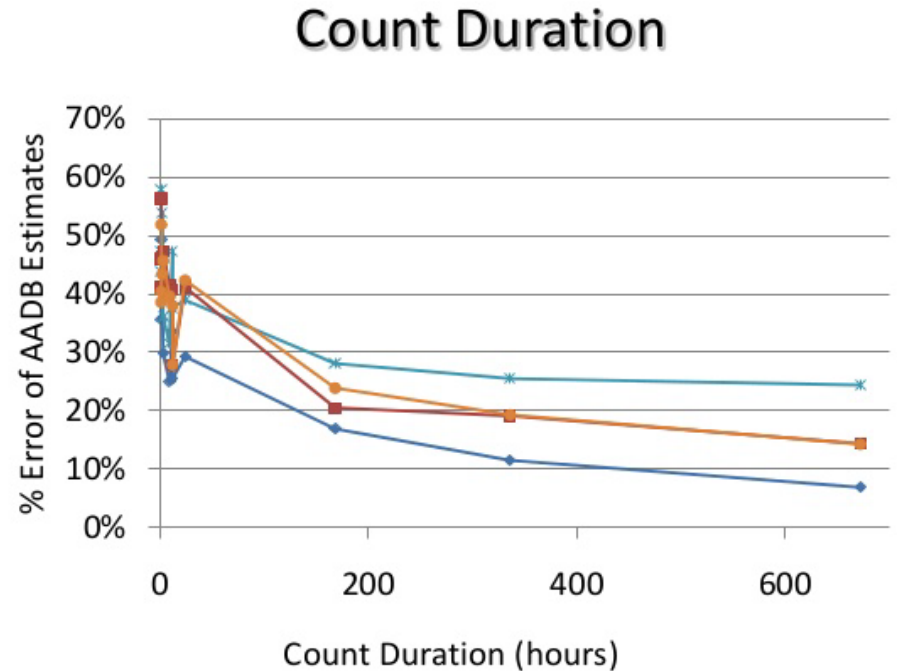


# Short-Term Counts

Provide spatial coverage of the network.

## Duration

- 7 day counts give time of day and day of week data for TPG sorting
- Past 7 days increases in accuracy slow in comparison to cost



# Short Term Counts

## Frequency

All sites should be counted at least once every five years.

Sites can be prioritized for increased frequency based on a variety of factors including:

- Bookending facility installation
- High expected growth
- High profile
- Exposure analysis

# Quality Assurance

## Site Selection, Installation and Calibration

- Highly specific to the type of TME being used.
- Consult with manufacturer and review all documentation
- Monitor sites for environmental changes

## Verification

- Tests to evaluate whether TME accuracy is acceptable
- Reference accuracy levels are available in NCHRP 797

# Quality Assurance

## Correction Factors

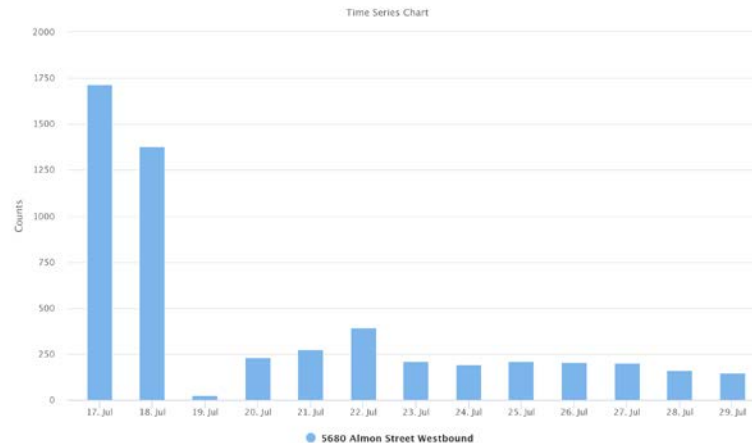
- Compensate for systemic inaccuracies caused by occlusion, bypassing, environmental, and site-specific conditions.
- Compare Accepted Reference Volume (ARV) with TME output volumes.

$$\frac{1}{n} \sum_{n=1}^{30} \frac{ARV_n}{output\ volume_n}$$

- ARVs are collected manually over 8 hours using 15 minute intervals.

# Validation and Cleaning

Even with proper installation, calibration and correction, errors will still occur.



## Short Duration Counts

- Visual review with comparison to geographically or statistically similar datasets.
- Rejected counts can be repeated.

# Validation and Cleaning

## Continuous Counts

Expansion factors require  $\geq 1$  week of data per month.

$\therefore$

*Schedule manual review after first week of each month.*

Validation criteria for automated flagging

- Consecutive zeros
- Zero/identical volumes
- Maximum hourly proportion
- 3am vs 3pm volumes



# Expansion Factors

Expansion factors are used to convert short duration counts to annualized statistics.

1. Convert continuous counts to AADT using AASHTO Hourly Method

$$\frac{1}{7} \sum_{d=1}^7 \left[ \sum_{m=1}^{12} \left( \sum_{h=1}^{24} \left\{ \frac{1}{n_{hdm}} \sum_{i=1}^{n_{hdm}} VOL_{idhm} \right\} \right) \right]$$

# Expansion Factors

2. Calculate traffic ratio's from AADT using

$$TR_{md} = \frac{MADWT_{md}}{AADT}$$

3. Summarize short duration counts into daily volumes.

4. Multiply daily volumes by  $TR_{md}$  to get AADTs.

5. Average calculated AADTs.

# Expansion Factors

Used to account for temporal variations in order to make data comparable. Time of day and monthly are typical.

**Other factors can also be developed through similar means.**

Precipitation/wind factors can be applied on top of expansion factors.

Partial day counts can be expanded into full day counts but not AADTs.

# Dissemination

Present data in a meaningful, contextualized manner without editorializing.

# Implementation

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# Key Goals for 2019/20

Install 4-6 permanent counters at strategic locations

Determine traffic pattern groups from continuous sites.

Procure portable multi-modal counter (pedestrians and cyclists)

Prioritise and schedule short term count sites

Develop expansion and adjustment factors based on existing data sources.

Standardise short term counts for dissemination.

Aggregate data into centralised location

# Locations



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# Permanent Locations



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# Permanent Counters

Permanent count sites have been selected to try and cover diverse spectrum of

- Facility type
- Land Use
- Geographic Area

While taking advantage of project integration

# Short Duration Locations



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# Short-Term Counts

Split facilities up into discrete sections and sample at minimum every 5 years

5 year frequency requires minimum of 10 counts per year.

## **Prioritization 2019/20**

- Facilities entering construction
- Facilities in planning

# Expansion

Geographical expansion can take place once the regional centre has been sampled.

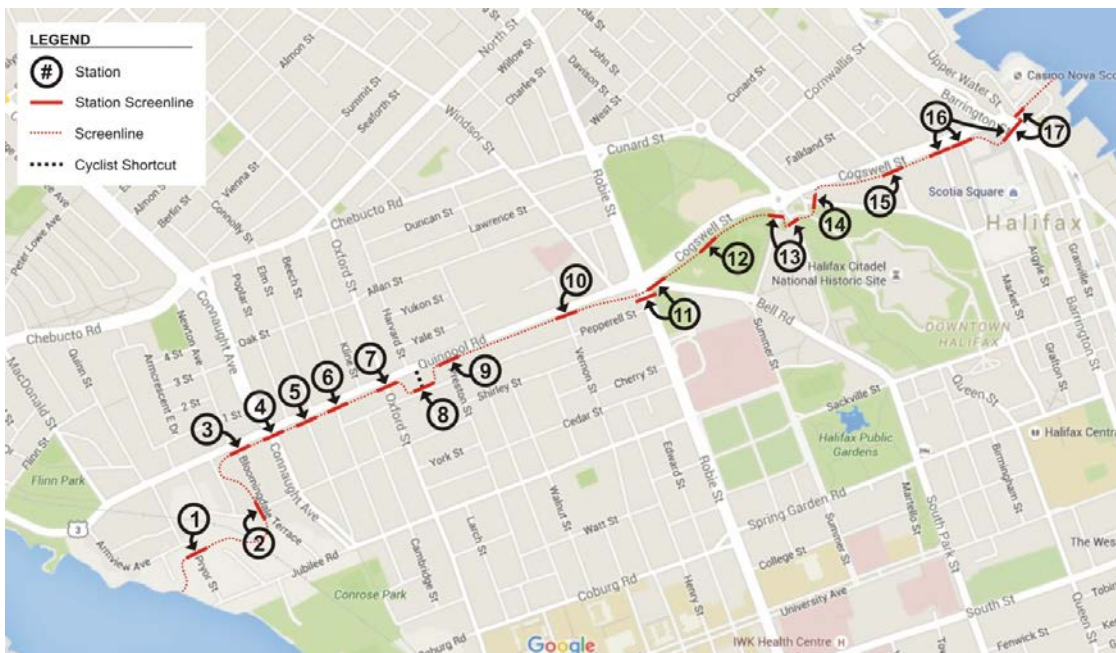
Regional trail sampling provides easy rural and suburban facilities with historic counts for comparison.

Depending on what TPGs are determined, permanent count sites should eventually be expanded to 3-5 counters per TPG with wide geographic coverage.

If data set is sufficiently complete, create day of year factors.

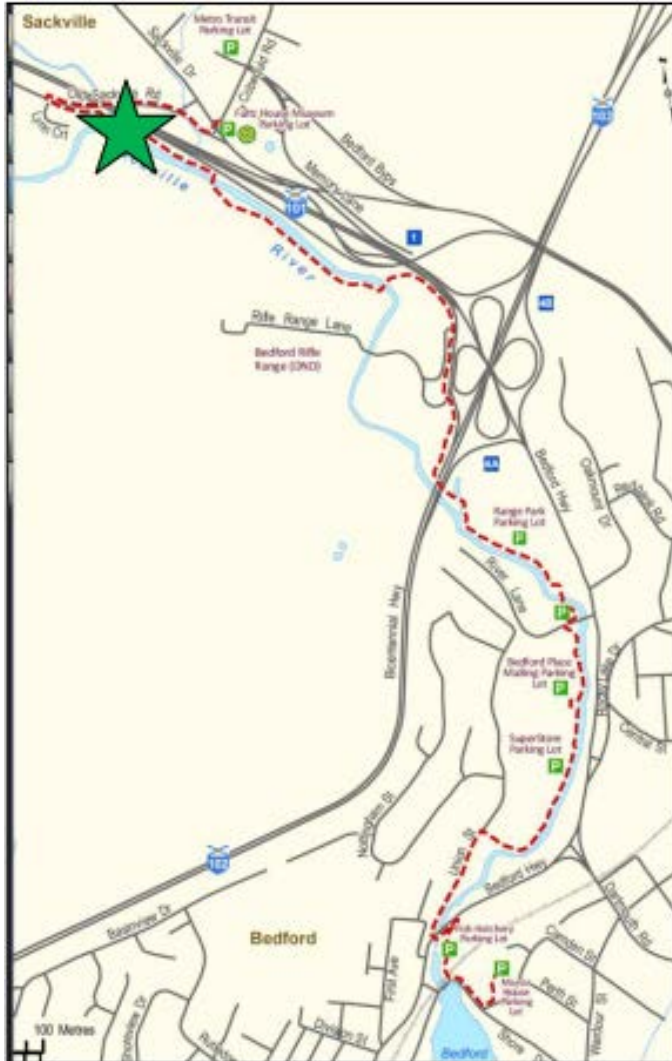
# Peninsula Screenline

- Returning to manual data collection provides valuable demographic and behavioral information
- Reintroduce pedestrian counting
- Building on an existing dataset provides early look at long term trends



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# Trail Counts



Continue to support trails groups in their counting efforts.

Sackville Rivers Association has entered their 7<sup>th</sup> year of continuous collection with plans to begin a second continuous count.

CHPTA have installed a pedestrian and bicycle counter on the Salt Marsh Trail.

# External Opportunities

## **Downtown Halifax Business Commission**

- 6 pedestrian counters located across the downtown

## **DaITRAC**

- University Ave and Sexton Bikeway

## **Halifax Harbour Bridge Commission**

- Possible Eco-Counter installation

- **Consultant Data Collection**

# Internal Integration

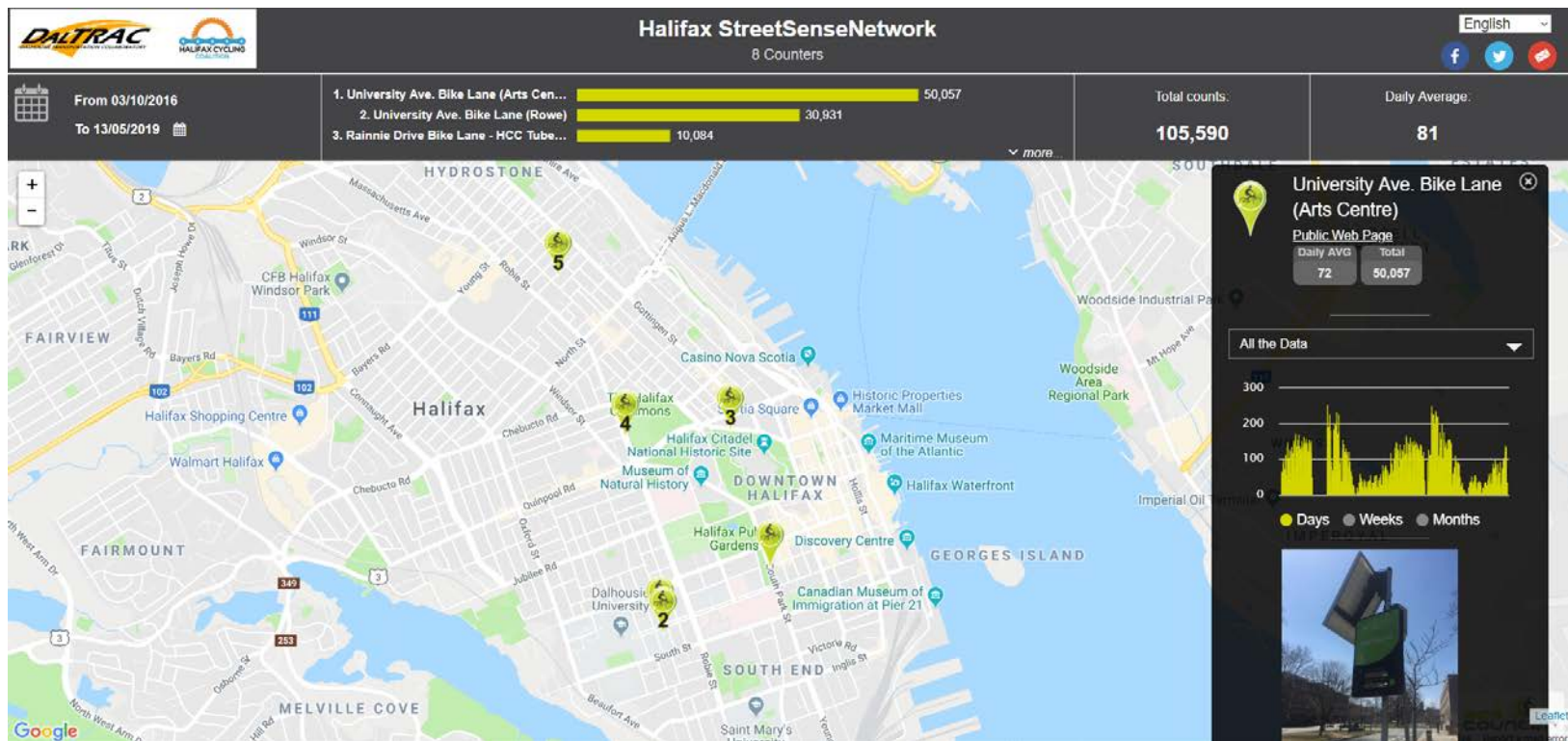
Look for opportunities to integrate with other counting efforts such as:

- Classification counts for asphalt design
- Gridsmart expansion and other signal detection
- Permanent count sites for annual screenline volumes



# Dissemination

Eco-Counter Public portal offers turn-key solution to continuous count site dissemination.



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# Dissemination

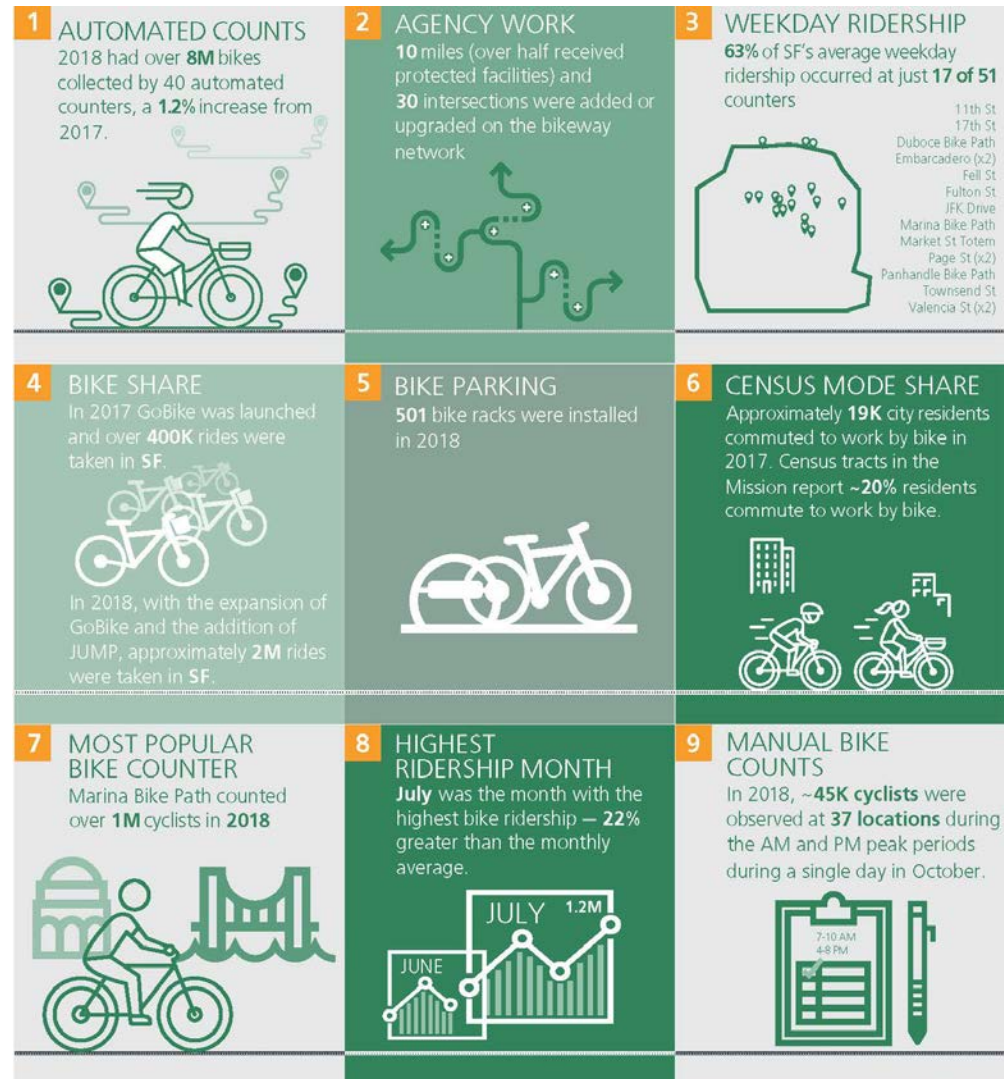
- On street displays provide immediate feedback and promotion to both users and non-users.
- Well placed units reach a wide, diverse audience.



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# Dissemination

Report Cards are an effective way to disseminate in an easily promotable and digestible format.

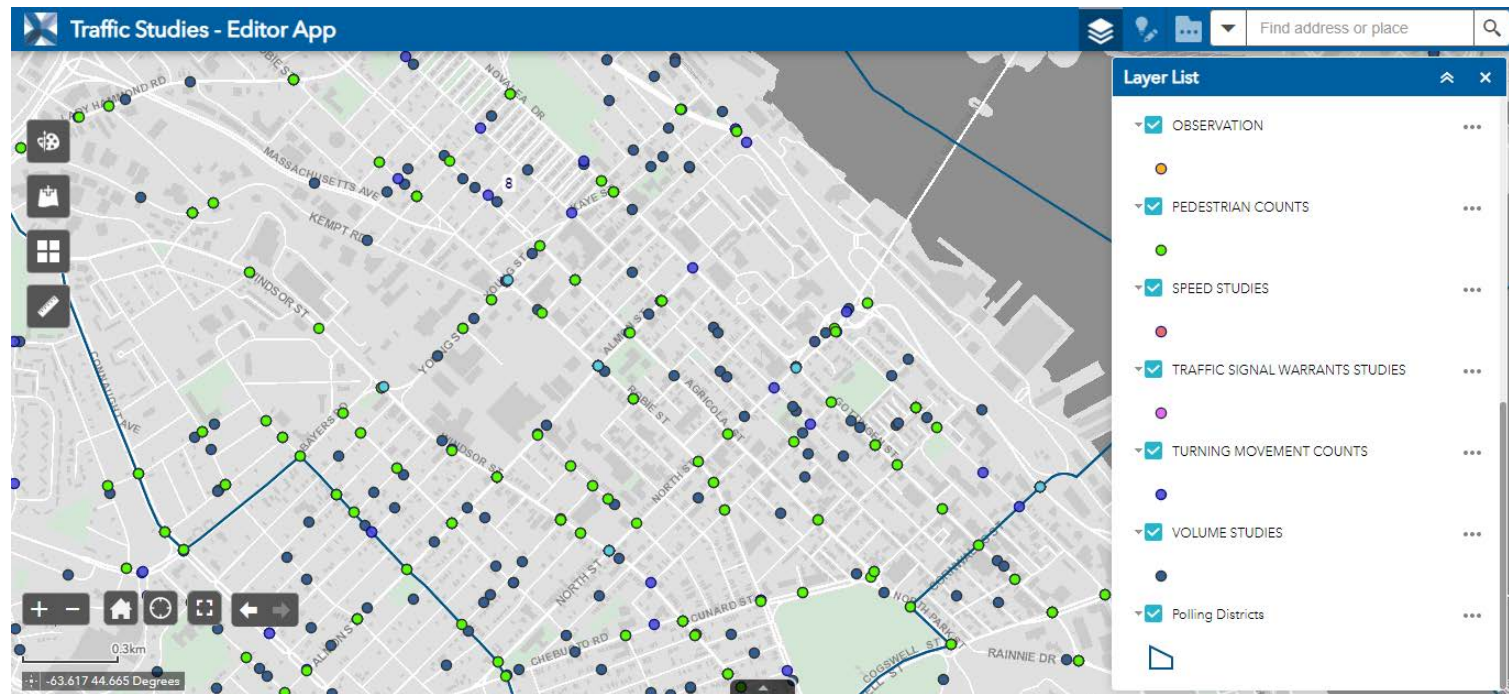


SFMTA Bicycle Findings

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# Dissemination

- Traffic Studies database is an ArcGIS based web app
- Allows for aggregation of data from any source



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# Emerging Technology

Emerging technologies promise exciting developments for data collection in the future.

**STRAVA**

METRO

 airsaage

NUMINA

iteris®

Tracking pedestrian use of crosswalk buttons could provide a proxy statistic for pedestrian volume trends across the municipality.

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# Summary of Goals

- Consolidate data collection from sources that already exist
- Continue strategic rollout of HRM operated permanent counter sites and plan for expansion of the program
- Continue to prioritize and schedule yearly short term counts
- Sort short duration counts into traffic pattern groups and review and update TPG's on regular basis
- Develop expansion factors using permanent counters and update on regular basis
- Implement quality control measures in data collection
- Reevaluate and identify areas of improvement

**Questions?**

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