# Collecting Network-wide Bicycle and Pedestrian Data: A Guidebook for When and Where to Count

WA-RD 875.1

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A Guidebook for When and Where to Count**

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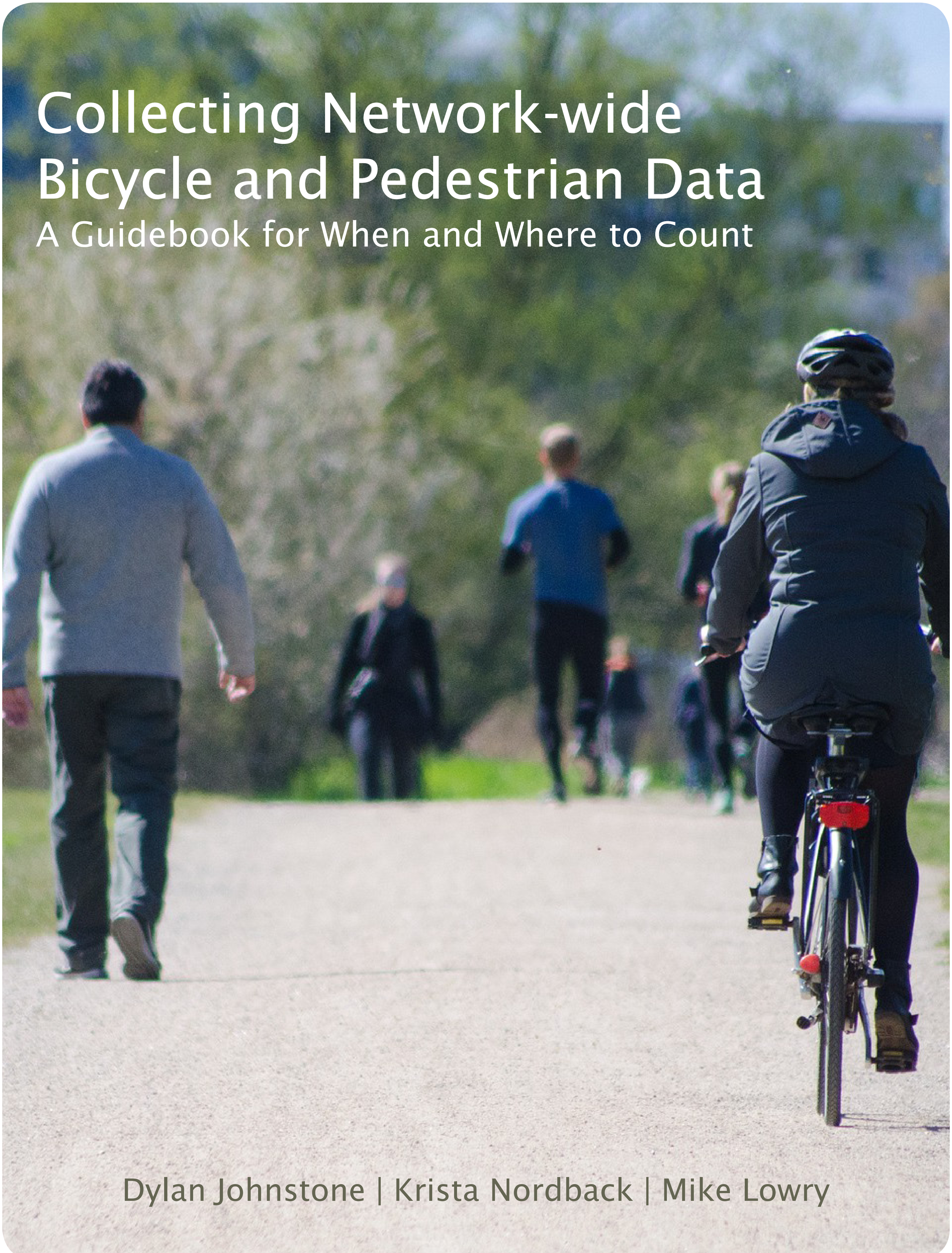
# Collecting Network-wide Bicycle and Pedestrian Data

## A Guidebook for When and Where to Count



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September 2017

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*Source: Angelo Giordano*

# Table of Contents

# 1. Introduction

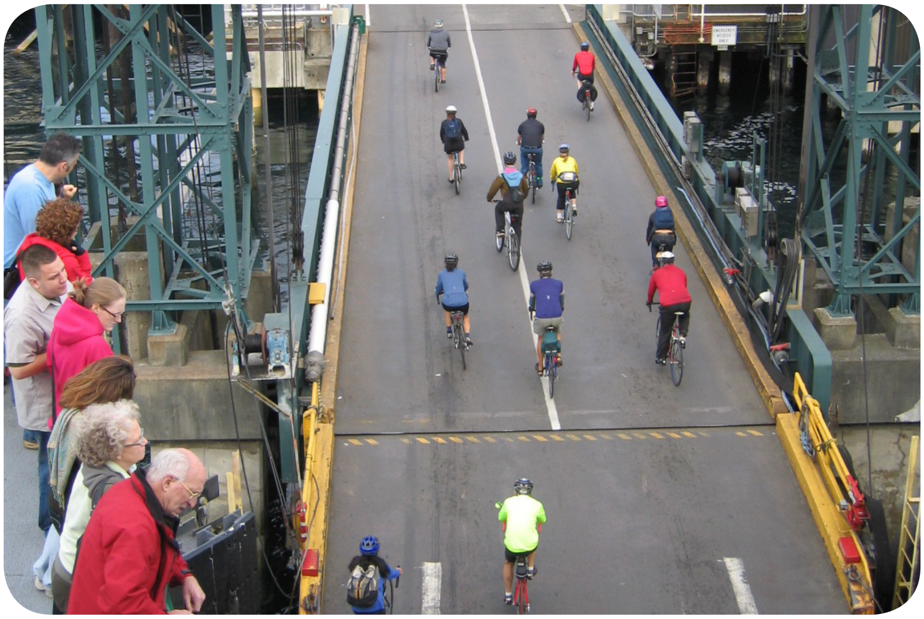
## Purpose

The purpose of this guide is to provide recommendations for collecting network-wide bicycle and pedestrian count data. Communities within the State of Washington can use this guide to establish a ***network-wide count program*** to help measure bicycle and pedestrian travel over time on a network.

Network-wide count data can be used to understand which corridors see the largest bicycle and pedestrian traffic volumes. This data can be used at the facility level for funding decisions, planning, and design.

Common metrics that can be estimated from network-wide count data are:

- ***Annual Average Daily Non-motorized Traffic (AADNT)***: The total bicycle and pedestrian traffic crossing a location in both directions for one year divided by 365 days. This metric is often separated into AADBT and AADPT for bicycle traffic and pedestrian traffic, respectively.
- ***Bicycle Miles Traveled (BMT) and Pedestrian Miles Traveled (PMT)***



Source: pedbikeimages.org / Carl Sundstrom

Similar metrics are used to measure motor vehicle traffic, namely Annual Average Daily Traffic (AADT) and Vehicles Miles Traveled (VMT).

These metrics are used for calibrating regional and local travel models, fulfilling state and federal reporting requirements, such as Target Zero and ResultsWA, applying for federal funding, conducting safety analyses, designing roads and paths, analyzing health and economic impacts from transportation, and justifying new or improved facilities.

# How to Use This Guide

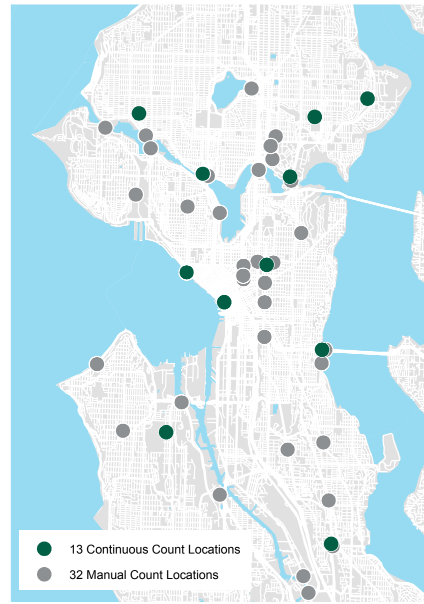
This guide will discuss what is needed to understand and set up a network-wide count program:

> Different types of count data
> How, where, and when to collect count data
> Steps to estimate annualized planning metrics for bicycle and pedestrian travel

Where appropriate, this guide offers specific recommendations for the Washington State Bicycle and Pedestrian Count Program managed by the Washington State Department of Transportation (WSDOT), which includes manual short duration and continuous counts.

Look for this outline around recommendations

***Key terms are highlighted in bold/italics*** and defined in the Glossary and Acronyms at the back of the guidebook.




Seattle's network-wide count program, 2016

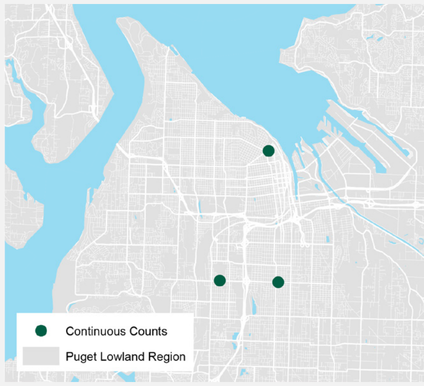
Uses for annualized count estimates include:

> Safety analyses
> Planning and design
> Project prioritization and funding
> Trends over time
> Economic impact studies
> Public health studies
> Signal timing
> Regional and local travel model validation

## Figure 1. Overview of How Network-Wide Count Programs Work

### 1. Data Collection

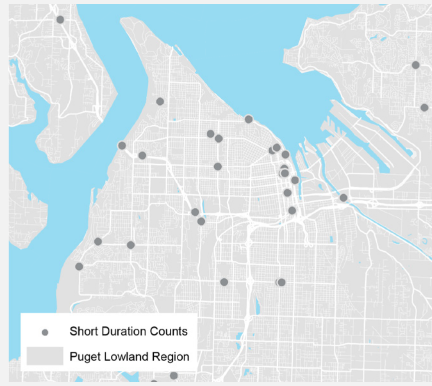
Network




Automatic counters collect continuous data at select locations.

+

Network

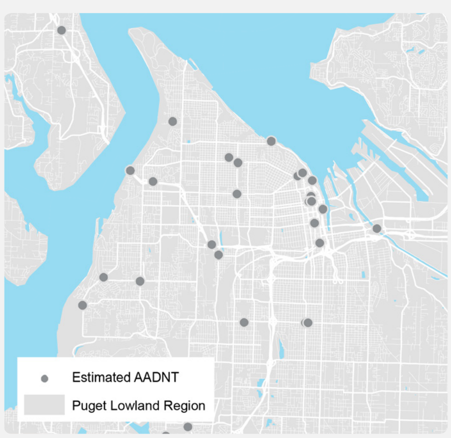



Volunteers, staff, or interns collect short duration count data across a network (“coverage” data).

### 2. Create Adjustment Factors from Continuous Data

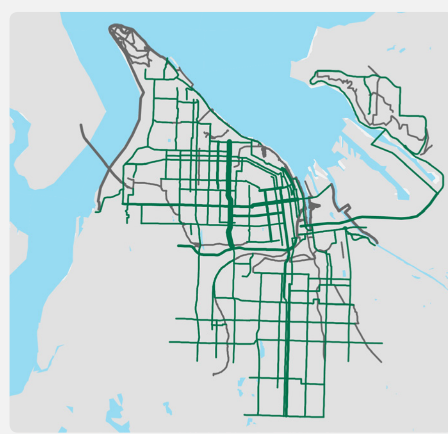
This guidebook provides adjustment factors for 2015 and 2016 in Table 5. Guidance for creating factors is outlined in the Appendix.

### 3. Apply Adjustment Factors




Adjustment factors are applied to short duration count data to estimate network-wide point AADNT. This can be calculated by hand or using Excel.

### 4. Estimate Segment AADNT (optional)



Network-wide point AADNT is extrapolated to network-wide segment AADNT. The online tool discussed in the Appendix calculates AADBT for bicycles

# Other Data Collection Methods

There are many other methods to collect bicycle and pedestrian data not included in this guidebook. The following methods can be used by communities to support and enhance their network-wide count program.

## Project-Specific Counts

To understand the change in bicycle and pedestrian traffic for an individual project, it is best to collect short duration counts that are chosen purposefully for that project. For example, count locations and count times can be chosen specifically for a before/after infrastructure improvement or a safety study.

## Travel Surveys

A travel survey, such as the the Puget Sound Regional Travel Study, helps to understand how people move from place to place for different types of trips and answer questions related to mode split.

## Intercept Surveys

To better understand who is using a given facility and for what purposes, one could use an intercept survey to stop pedestrians and cyclists so they can answer a few questions about their trip. Intercept surveys are also best for collecting qualitative data about a user's experience on a facility. Reference the National Bicycle and Pedestrian Documentation Project (NBPDP) for an example of a standard intercept survey.

## GPS Trace Data

Cyclists, runners and walkers sometimes choose to use apps such as Strava, RideReport, Ride with GPS, Map My Ride, and other regional apps to track their rides. Data from these apps can produce a map of where cyclists are riding. While who chooses to use these apps is self-selecting and thus a biased sample of the population, when combined with count data, these GPS traces can produce a more robust picture of cycling on the network. However without count data, they give only a picture of one segment of the population. Since count data is critical to using GPS data, we focus the rest of the guide on count data, which is foundational for studying cycling and walking.

Stone Way Rechannelization: Before and After Study

After removing motor vehicle lanes and adding bike lanes to Stone Way North Street, the City of Seattle observed through project-specific counts:

25% ↑
Number of cyclists

12-34% ↓
Motor traffic on adjacent streets

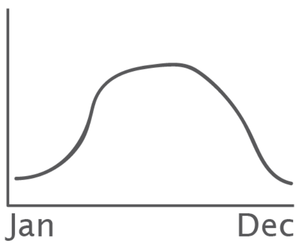
80% ↓
Speeding

14% ↓
Collisions

*Source: SDOT, People for Bikes*

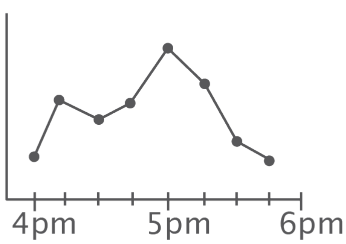
# 2. Types of Count Data

There are three types of count data (1) permanent continuous, (2) short duration coverage, and (3) short duration project-specific. Network-wide count programs, such as Washington State's Bicycle and Pedestrian Count Program, focus on the first two types of counts.




1 year+

Permanent, continuous




2 hours - multiple weeks

Short duration

Network-wide count programs

## Permanent | Continuous

This type of count requires installing equipment that can monitor bicycle and pedestrian volumes constantly for at least one year. The resulting ***"continuous" data*** is vital for any count program.

Continuous data provide the only way possible to identify variation in facility volume throughout the day, week, and year. This information can be used to understand the effects of weather and temperature. Most importantly, continuous data is necessary to create adjustment factors for expanding short duration counts.

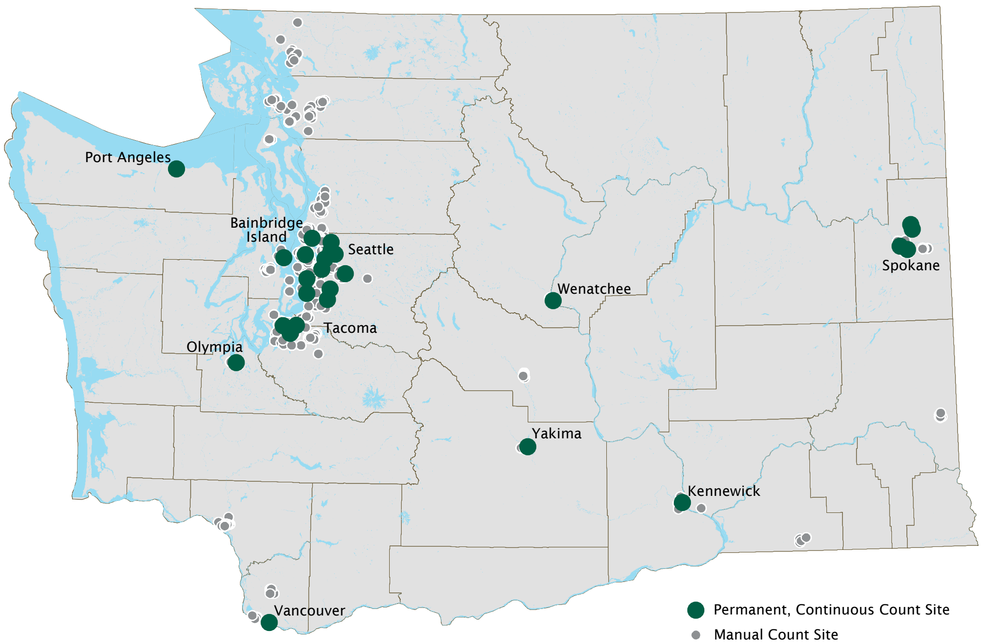
## Short Duration | Coverage

This type of count occurs repeatedly throughout the year and over a period of years. The underlying goal is to collect ***"coverage" data*** for a wide geographic area.

The counts are collected for relatively short periods that usually range from 2 hours to multiple weeks. Counts that take place across multiple weeks require automatic counting equipment discussed in the next chapter. See Chapter 5: When to Count for recommendations on how long and often to count.

Recommended

Map 1. WSDOT Bicycle and Pedestrian Count Program




*Source: Data obtained from WSDOT Bicycle and Pedestrian Count Program database*

# Short Duration | Project-Specific

This type of count is done for special studies or specific projects. The scheduling of these counts is typically dependent on project timelines, e.g. before, during, and after project completion.

Sometimes project-specific data is collected with a greater level of detail than for coverage counts. For example, a study for traffic signal timing might include information about pedestrian delay and queuing. A study for signal warrant analysis or safety analysis might focus on crosswalk volumes.

# 3. Counting Methods

This section describes automatic and manual counting methods. Both counting methods are critical to WSDOT´s count program. Automatic counting methods provide the only means to collect continuous data and can also be used for short duration coverage counts. There are various "portable" technologies that can be circulated around a community to attain wider geographic coverage.

Manual counting can provide data that are difficult or impossible for machines to detect, such as perceived gender, age, ethnicity, or helmet use, but it is difficult for a single human to accurately count longer than two hours at a time. Manual counts are useful for collecting coverage data from a wide geographic area, and if using volunteers a well-organized count program can be relatively inexpensive to implement.

Inductive loops

## Automatic Counting Methods

This section discusses a variety of the most commonly used automatic counting methods. The NCHRP 797 Report* provides more information on these and other counting methods, installation considerations, limitations, and accuracy (Ryus et al. 2014, Ch 3.2.4 and Ch 5). Below is a summary of the most common technologies used for bicycle and pedestrian counting.

Piezoelectric strip

### Counting Equipment

#### Inductive Loops

Inductive loops are usually cut or embedded into pavement permanently to detect the metal wheels of bicycles passing over them.

#### Piezoelectric Strips

Bicyclists can be detected using piezoelectric strips permanently embedded in pavement using electrical signals. Piezoelectric strips can detect directionality and speed for screenline counts.

Pneumatic tubes

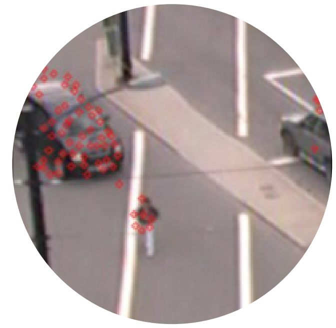
#### Pneumatic Tubes

Rubber tubes are placed, usually temporarily, across a path or roadway to count bicyclists. As a bike passes over the tube, a pulse of air travels to a detector that records the count. These are generally used for temporary installations.

*NCHRP 797 Report is available as a free reference at
http://www.trb.org/Publications/Blurbs/171973.aspx

## Automated Video

Algorithms are used to count pedestrians and bicyclists from video recordings for screenline, crosswalk, or intersection counts. Due to limits in data storage for video images, this type of collection is generally used for less than a week at a time.



Automated video, *Source: Ismail et al., 2009*

## Passive Infrared

Passive infrared detectors sense pedestrians and bicyclists, comparing infrared radiation patterns emitted by persons with background temperature. A battery-powered passive infrared sensor is mounted (temporarily or permanently) on one side of the facility being counted.

Infrared counting technology cannot differentiate between bicyclists and pedestrians and thus is best used on pedestrian-only facilities such as sidewalks and pedestrian trails (as in photo) or on shared-use facilities in combination with a bicycle-only detector, such as inductive loops, piezoelectric strip or pneumatic tubes. In the latter case, the bicycle count can be subtracted from the total user count to obtain the pedestrian count.

Passive infrared

### Figure 2. Simplified Flowchart for Selecting Non-motorized Count Equipment

**1. What Are You Counting?**

**2. How Long?** Permanent ↔ Temporary/ Short Term

| 2. How Long? | 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 | ○ | ○ | ○ | | $$ |
| | Video Imaging: Automated | ○ | ○ | ○ | ○ | $-$$ |
| | 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.

## Using Portable Automated Counters for Short Duration Counts

Pneumatic tubes can count bicycles, and when combined with infrared pedestrians and bicycles can be counted separately. Alternatively automated video can count both bicyclists and pedestrians. However, no matter what technology or combination of technologies is used, thorough validation of new equipment and basic validation at each installation is essential for obtaining accurate counts, discussed in the next section.

Some jurisdictions in Washington already collect short duration counts using automated equipment. For example, Olympia that has adapted pneumatic tubes usually used for motor vehicle counting for week-long bicycle counting. A simple guide developed for the Oregon Department of Transportation describes what pneumatic tube counting equipment have been found to work well and how and where to install.*

Automated counts can be integrated into existing motor vehicle counting programs to reduce staff time and maximize efficiency. This is especially possible for bicycle counting using pneumatic tubes.

Alternatively, passive infrared counters, for example, are relatively easy to install with minimal training. City staff or local non-profits, the public health community, parks departments and others in a community could install and move portable automated counters. A set of these could be purchased by a city and set up at the selected count sites by volunteers or partner organizations, if city staff are not available to do so. However, some minimal training will be required so that all installers will be able to set up equipment properly, perform basic validation and download data. A recent report from Minnesota DOT** documents how they operate a count equipment loan program in their state, as an example of what could be one on a smaller scale at the community level (Lindsey et al. 2017, p9-11).

*ODOT Guidebook for Counting Bicycles with Pneumatic Tubes is available at *http://www.oregon.gov/ODOT/Programs/ResearchDocuments/SPR772_Guidebook_AppendixFINAL.pdf*
**The Minnesota Bicycle and Pedestrian Counting Initiative: Institutionalizing Bicycle and Pedestrian Monitoring Report (P9-11) is available at *http://www.dot.state.mn.us/research/reports/2017/201702.pdf*

Passive infrared and pneumatic tubes combination

## Equipment Validation

Regardless of what technology is chosen, it is critical that the technology be validated to make sure it is actually counting bicyclists and pedestrians and not passing cars and trucks. When starting to use a new temporary counting technology or installing a permanent counter, it is critical that the jurisdiction installing the equipment takes the time to validate their equipment. A thorough validation includes recording two days of video at a site and comparing the bicycles and pedestrians manually counted from video with the counts reported by the automated equipment. NCHRP 797 provides detailed guidance on how to do this.

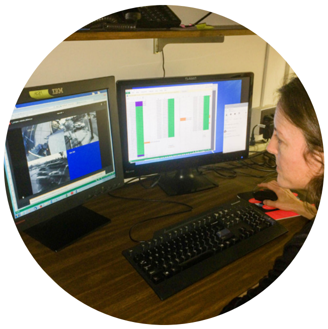
### Portable Automated Counters

Of course, it will not be possible to do a thorough validation at every temporary installation, but when starting with new equipment it is essential.

After the thorough validation has been conducted and the staff at the jurisdiction is satisfied with the accuracy of the portable automated counting equipment, it is still necessary to do basic validation checks whenever the equipment is set up. This could be simple validation that at least 10 cyclists and/or pedestrians are correctly counted at a given site after setup. If the site is low volume, have a bicycle available at installation to ride over the detection area for this basic validation. Conducting this simple test immediately after each temporary installation will reduce the chance that a week of data will be inaccurate or registering zeros and have to be thrown out and recollected later.

Validation and calibration are necessary with portable/temporary counters. When staff from Oregon DOT used their standard pneumatic tube setup to count bicycles, researchers at Portland State University found that only 30% of cyclists were counted. Fortunately, low cost changes in equipment set up can be made to accommodate bicycles as documented the ODOT Guidebook for Counting Bicycles with Pneumatic Tubes*.

Manual in-person



Manual video

Crosswalk counts are not included within the scope of this guidebook.

Consider using pneumatic tubes and infrared counters as an alternative to manual counts at low-volume locations where it is often boring for a volunteer count.

# Manual Counting Methods

The most common methods to count bicyclists and pedestrians are screenline counts, intersection counts, and crosswalk counts. Both screenline and intersection counts may be collected either through in-person manual counts or video recorded counts that are manually processed.

## Screenline Counts

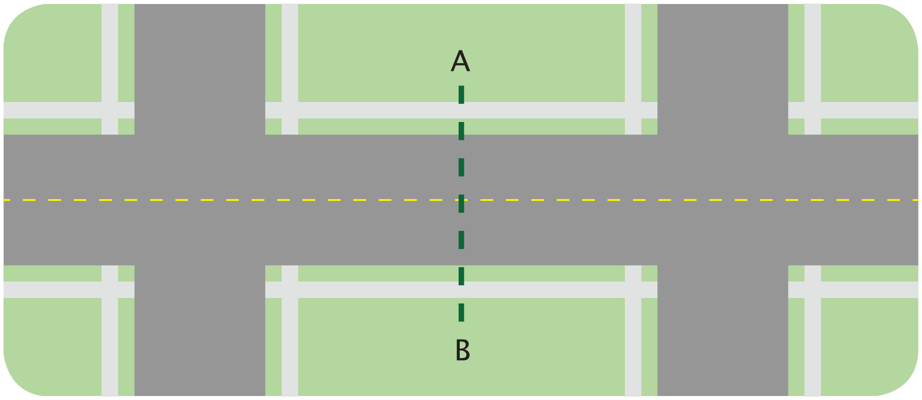
Screenline counts are conducted at midblock locations on road or trail segments. Conduct counts where access and egress to the street or trail is minimal, i.e. away from doorways or entrances to parking lots. Figure 3 shows the preferred locations for two example segments. Bicyclists and pedestrians are counted in both directions, with a unique tally for eastbound or westbound (northbound or southbound) movement. The screenline method is also simple enough that in many cases, one person can also collect information on gender and helmet use simultaneously.

### Advantages

- Easiest manual count method to use
- Straightforward to calculate planning indicators (AADNT, PMT/BMT)
- Data corresponds with most automatic counting methods
- Comparable to most short duration motorized traffic counts
- Easy to switch to continuous counting in the future while preserving a compatible historical record
- Simplicity makes it easier to train volunteers and obtain reliable data from them

Recommended

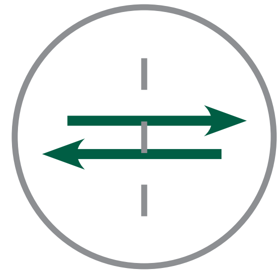
Figure 3. Recommended Location for Screenline Counts



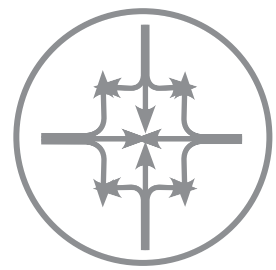

Screenline counts are best collected midblock on a segment of roadway or trail.

## Intersection Counts

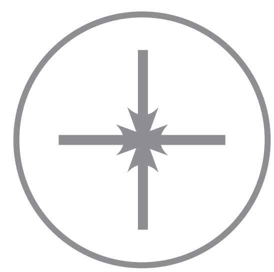
Intersection counts involve counting the movement of persons entering the intersection from every direction (usually four directions at a typical crossroad or three directions at a T-intersection), or the movement of persons leaving the intersection toward each direction, or all 12 movements for turning and through travel.



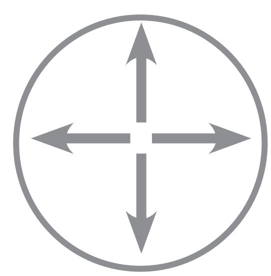
Screenline (Recommended)



12-movement (Alternative)



4-movement entering (Not recommended)



4-movement leaving (Not recommended)

Neither of the “4-movement” methods shown should be used to determine AADNT and BMT or PMT. This is because it is not possible to back out and understand what is happening at the legs of the intersection. Instead, these methods are aimed at calculating intersection totals. The 4-movement leaving method can produce errors at busy intersections because the person conducting the count must wait until the pedestrian or bicyclist has completely finished their movement before a tally can be recorded. The same is true for the 12-movement method.

However, the 12-movement method has the advantage of providing substantially more information compared to the other methods. In fact, the 12-movement method essentially captures the same information as four screenline counts plus turning movements. The 12-movement method is also backward compatible with the 4-movement counts. However, it is not advisable to collect information on gender or helmet use during 12-movement counts as it becomes too complicated and prone to error for a single volunteer to collect.

To avoid the additional complexity and for the reasons previously mentioned, the screenline method is recommended for all short duration coverage counts.

# 4. Where to Count

This section describes how to create a list of coverage count sites and select from that list each year and gives basic guidance on selecting continuous count sites for permanent automated counters.

## Creating a List of Coverage Sites

### How Many Coverage Count Sites

This research funded by WSDOT recommends a goal to count at 3,600 locations statewide, with one-third (1,200) of the locations to be counted each year.

This guide does not include selecting locations for project-specific counts, which should be dealt with in a separate count program.

It is not possible to count everywhere, so combining counts with other data sources such as GPS trace data discussed previously or other geographic data, can help fill in bicycle and pedestrian volumes in locations not counted. This is especially helpful for bicycle volumes. For pedestrian volumes, count data can be used to create statistical models using land use, socio-demographic, and other variables to estimate volumes where counts are not conducted. However, both GPS and statistical modeling approaches rely on a program of counts for validation and calibration.

At the community level, count organizers can identify roughly 30 count sites for every 100 centerline miles of roadway in their community. Counts can be collected every third year, so there should be about 10 locations per year per 100 centerline miles of roadway.

$$\textit{Minimum number of short duration coverage sites collected per year} = 0.10 * \textit{Total centerline miles of roadway}$$

Recommended

For example, a small community with 84 centerline miles of roadway would conduct a short duration count for at least 8 sites every year. For Seattle, the largest city in the state with 1,677 centerline miles, there should be a minimum of 167 short duration counts per year.

Seattle or other large cities might decide to achieve their annual goal by conducting more than one count event per year. For example, by conducting a spring, summer, and fall count event, Seattle could achieve the annual goal with roughly 55 count sites during each count event. Note this includes manual counts from volunteers as well as short duration counts collected using automated equipment that is placed at a location temporarily for the count event.

## Table 1. Example of Determining Minimum Number of Coverage Count Sites

| Example Community | Size | Centerline Miles of Roadway | Minimum # of Sites Collected per Year | Minimum Total # of Sites Collected Every 3 Years |
|---|---|---|---|---|
| Pullman | Small | 84 | 8 | 24 |
| Vancouver | Medium | 600 | 60 | 180 |
| Seattle | Large | 1,677 | 167 | 501 |


Arterial/highway
Hood Canal Bridge
*Source: WSDOT*

# Selecting Coverage Count Sites

Select coverage count sites randomly from a minimum of 3 strata:

- Arterials and expressways
- Local roads and collectors
- Shared use path or trail


Local/collector
Neighborhood greenway, Seattle

To do this, make a list of roadways (or ideally road segments) in each of the strata. Communities may identify additional strata based on where bicycle and/or pedestrian volumes may be higher or lower. For example, roads and paths around a university may be designated as a separate strata or if the community has a major river, roads across the bridge may be a separate strata.

Below are a high-tech and low-tech option for selecting count sites from these strata.

*High-tech method*- If GIS is available, compile a list of road segments into an Excel file and use a random number generator function to randomly select sites from each strata.


Path (unpaved or paved)
Des Moines Creek Trail
*Source: WSDOT*

*Low-tech method*- Write a list of the high and low volume bicycle and pedestrian routes in the community. Organize the list by strata and pick a random sample (draw from a hat) from each strata.

Select as many sites as needed to reach the recommended total number of short duration count sites to be collected every 3 years based on community size.

## Selecting Continuous Count Sites

This guide assumes that sufficient continuous count sites (the TMG recommends 3-5 per factor group) have already been installed, but what if your region doesn't have at least 3 sites per group?

Choosing a permanent continuous count location requires a different set of criteria than when choosing a short duration site. Below is a list of considerations:

- Representative locations: Unlike short duration sites, continuous counting locations should be chosen deliberately, not randomly. Ideally, sites that are representative of the area are best.
- Know the limitations of the technology. Each counting technology works well only in specific conditions (See NCHRP 797 for details). Below are some general good practices:
    - Counting people walking or bicycling side-by-side is challenging for most equipment, so select sites where people are more likely to walk or bicycle single file.
    - Avoid places where people bunch or congregate as these are hard for counting. No equipment does well when people are standing on or in-front of it. Choose places where people are walking or biking at a normal pace.
    - Avoid mixed traffic. Especially, places where nonmotorized traffic mixes with motorized traffic. It is challenging for the equipment to figure out who is who.
- If you have budget for multiple sites, select a variety of location types across different population densities (urban, rural...) and facility types (path, sidewalk, bike lane…). This will help identify different travel patterns that may be present.
- Nonmotorized traffic volume: It is good to have a range of different volumes, but generally moderate bicycle and pedestrian volume is good. If you have fewer than 100 users per day it can be difficult to use the data for reliable factors (although for rural locations, this is often unavoidable). Similarly sites with high traffic volume (over 1000 per day) can have problems with people frequently bunching (as when a traffic light, ferry or drawbridge lets out a lot of people at one time) which leads to undercounting, when the group is counted as one person.
- Generally, pinch points such as bridges over highways, railroads or rivers can make good locations because they funnel users to one place. This funneling can increase volumes and may make for a more representative sample of the surrounding area since

users from around the area may be drawn to cross at the chosen spot. In addition there is less chance of users congregating, standing in front of the counter, or walking side-by-side, if they are in a narrow pinch point and know someone else may be coming along soon.

- Keep in mind that the same site that works well for pedestrians may not work for bicyclists and visa versa.

Before installing a permanent counter, it is best to first get a week of count data from a portable counter in order to understand the travel pattern at that site, or at least conduct a set of four 2-hour counts as recommended in this guide to understand the pattern over the week and the day. This will allow you to understand which travel pattern is common at that location and if you need an additional counter with that travel pattern.

For example, let's say you are installing your first permanent counter. You looked at your sets of four 2-hour counts (as recommended in this guide) and see that most of the sites in your town have a commute pattern, so you are looking for a permanent site with a commute pattern (highest counts during evening and morning peak hours). You conduct a short duration count at the site you think will work well, but discover it has a recreational pattern (high on Saturday and weekday noon is high too). In this case, you should consider choosing a different site that better reflects the general travel pattern you observe elsewhere. This is critical, since the data from the continuous counter will be used to create adjustment factors for a given factor group (travel pattern) and if you invest in a permanent counter with an unusual travel pattern, you still won't have the data you need to estimate AADNT.

# 5. When to Count

## Automated Counts

The TMG recommends conducting short duration automated counts for a minimum of 1 week per site, such that all weekday and weekend days are represented, with 14 days prefered. This can be achieved by using portable automated technology such as those discussed previously on pages 10 and 11.

## Manual Counts

If it is only possible to do manual counts, count during non-holiday weeks and good weather from May through September. Count during four periods for a total of 8 hours for each site:

| | |
|---|---|
| Weekday (Choose one T, W, or Th) | 7:00-9:00am<br>11:00am-1:00pm<br>4:00-6:00pm |
| Weekend (Saturday) | 12:00-2:00pm |

Recommended

Ideally, manual counts should be collected in 15 minute time periods. The counts should be aggregated into time periods no greater than 1 hour, to be included in the federal database (FHWA 2016 TMG).

If counts can only be conducted annually, align counts with the National Bicycle and Pedestrian Documentation Project* dates in May and September. Alternatively, allow volunteers to count at their discretion in good weather during non-holiday weeks May through September (e.g., Portland, Oregon's manual bike count program).

Next, this chapter discusses how to use these four manual count periods to determine a site's travel pattern.

*National Bicycle and Pedestrian Documentation Project announces count dates at [http://bikepeddocumentation.org/](http://bikepeddocumentation.org/)

# Determining Travel Patterns

Non-motorized count sites demonstrate different ***travel patterns*** depending on the role of that particular facility in the network (e.g., commute, mixed or multipurpose, non-commute or noon activity). The travel pattern may strongly reflect the types of users based on when the highest and lowest volumes are observed, such as a strong commute pattern for bicyclists on the Fremont Bridge in Seattle between 7:00-9:00am and 4:00-6:00pm on weekdays.

Bicycle and pedestrian traffic have more variable travel patterns than motor vehicle due to factors such as users' sensitivity to weather and recreational use. This variability means that it is harder to accurately predict non-motorized traffic volumes using manual counts.

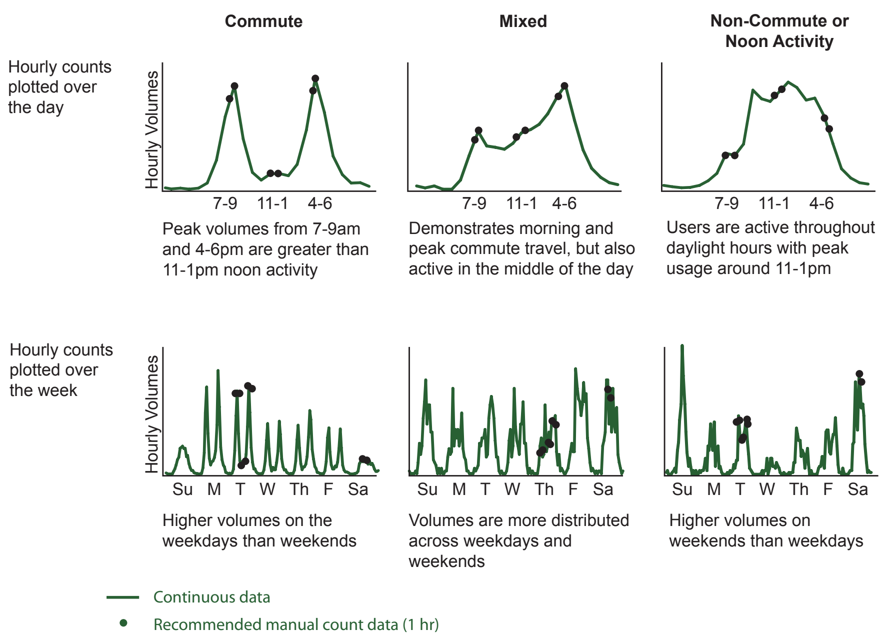
Travel patterns are best seen given continuous data for at least a full week (Figure 4). Manual counts only provide a brief snapshot of the daily and weekly patterns. For communities without resources to collect a full week of continuous data, it is preferable to conduct manual counts at the four recommended times for each count site. These manual counts will be used to compute the Weekend Ratio and Morning Ratio, explained in the next section. These ratios will compare a count site's daily and weekly patterns to more accurately predict its travel pattern.


Commute
Fremont Bridge in Seattle

Mixed
Woodland Trail in Olympia

Non-commute or noon activity
Apple Capitol Loop Trail at the Old Wenatchee Bridge
*Source: WSDOT*

## Figure 4. Daily and Weekly Travel Patterns




Continuous data for at least one week provides the easiest way to visualize travel patterns. But it is possible to determine travel patterns using manual counts as illustrated above.

## Calculating Weekend and Morning Ratios

The ***Weekend Ratio*** looks at the relationship between peak weekday hours and peak weekend hours. The ***Morning Ratio*** determines the difference between the weekday morning peak average and the weekday midday average (Miranda-Moreno et al. 2013). Both indices are needed to more accurately predict a count site's travel pattern.

$$\textit{Weekend Ratio} = \frac{\textit{Peak hour weekend traffic}}{\textit{Peak hour weekday traffic}}$$

*where:*
*Peak hour is the greatest hourly traffic volume counted during that day. For example, if between 4:00 and 5:00 PM 100 pedestrians are counted and between 5:00 and 6:00 PM 80 pedestrians are counted, the peak hour count is 100 pedestrians.*

$$\textit{Morning Ratio} = \frac{\textit{Average of weekday hourly traffic from 7am-9am}}{\textit{Average of weekday hourly traffic from 11am-1pm}}$$

Group the sites using the criteria in Figure 5.

Note that choosing the incorrect travel pattern for a site will increase error for annualized estimates described in Chapter 6.

### Figure 5. Determining Travel Patterns

| Travel Pattern | Weekend Ratio | | Morning Ratio |
|---|---|---|---|
| Commute | less than 1.0 | *and* | greater than 1.5 |
| Mixed or Multipurpose | less than 1.0 | *and* | less than 1.5 |
| | *-or-* 1.0 - 1.8 | *and* | greater than 1.5 |
| Non-Commute or Noon Activity | 1.0 - 1.8 | *and* | less than 1.5 |
| | *-or-* greater than 1.8 | *and* | any |

## Tables 2-3. Examples Using Manual Count Data

### Manual counts

| Day of Week | Time | Fremont Bridge Cyclists | Woodland Trail West Cyclists | Apple Capitol Loop Peds |
|---|---|---|---|---|
| Weekday (T,W,Th) | 7am | 151 | 20 | 11 |
| | 8am | 429 | 11 | 15 |
| | 11am | 140 | 16 | 39 |
| | 12pm | 107 | 10 | 36 |
| | 4pm | 385 | 31 | 9 |
| | 5pm | 651 | 38 | 11 |
| Saturday | 12pm | 99 | 5 | 100 |
| | 1pm | 92 | 5 | 10 |

*Source: Raw hourly data obtained through Seattle Department of Transportation and WSDOT via Eco-Visio, 2016*

### Example calculations

| | Fremont Bridge Cyclists | Woodland Trail West Cyclists | Apple Capitol Loop Peds |
|---|---|---|---|
| Peak hour weekend traffic | 99 | 5 | 100 |
| Peak hour weekday traffic | 651 | 38 | 39 |
| ***Weekend Ratio*** | ***0.15*** | ***0.13*** | ***2.56*** |
| | | | |
| Average morning traffic (7-9am) | 290 | 16 | 13 |
| Average midday traffic (11am-1pm) | 124 | 13 | 38 |
| ***Morning Ratio*** | ***2.35*** | ***1.19*** | ***0.35*** |
| *Travel pattern* | *commute* | *mixed* | *non-commute or noon activity* |

# 6. Annualizing Counts

Annual bicycle and pedestrian volumes can be estimated by applying adjustment factors to short duration data (also called inflating, extrapolating, or annualizing). This section will discuss grouping count sites into factor groups, an example of applying adjustment factors to manual count data, and the expected error associated with estimating annual average daily nonmotorized traffic (AADNT).

Count sites are categorized into factor groups using three criteria:

- Region
- Travel pattern
- Mode

## Determining Factor Groups

Counts sites with the same travel pattern are grouped together by region and mode, called ***"factor groups"*** (e.g., bicycle counts with a commute pattern in Puget Lowland, pedestrian counts with a non-commute pattern in Eastern Washington). There are four regions in Washington State: Coast Range, Cascades, Puget Lowland, and Eastern Washington.

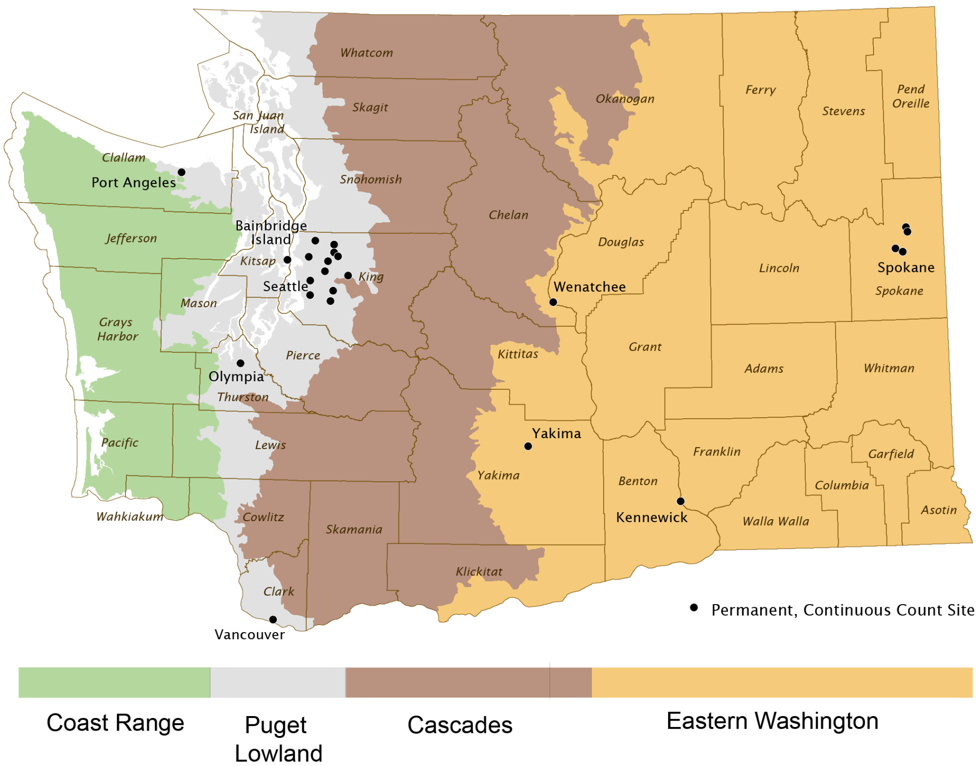
Each factor group has corresponding adjustment factors that are calculated using continuous data from communities within the same region. If a smaller community does not have resources for a continuous counter, they may consider using adjustment factors created from continuous data from another community within the same region (See Map 2). This is also useful when collecting short duration data from multiple communities and regions to determine statewide estimates.

Factor groups are used to calculate and apply adjustment factors to short duration counts in order to extrapolate the data to an annual estimate. Each factor group should have more than one continuous counter. The TMG recommends 3-5 per group.

### Table 4. Example of Determining Factor Groups

| Community | Region | Travel Pattern | Mode | Factor Group |
|---|---|---|---|---|
| Seattle | Puget Lowland | Mixed or multipurpose | Pedestrians | Puget Lowland - Mixed or multipurpose - Pedestrians |
| Yakima | Eastern Washington | Non-commute or noon activity | Bicycles | Eastern Washington - Non-commute or noon activity - Bicycles |

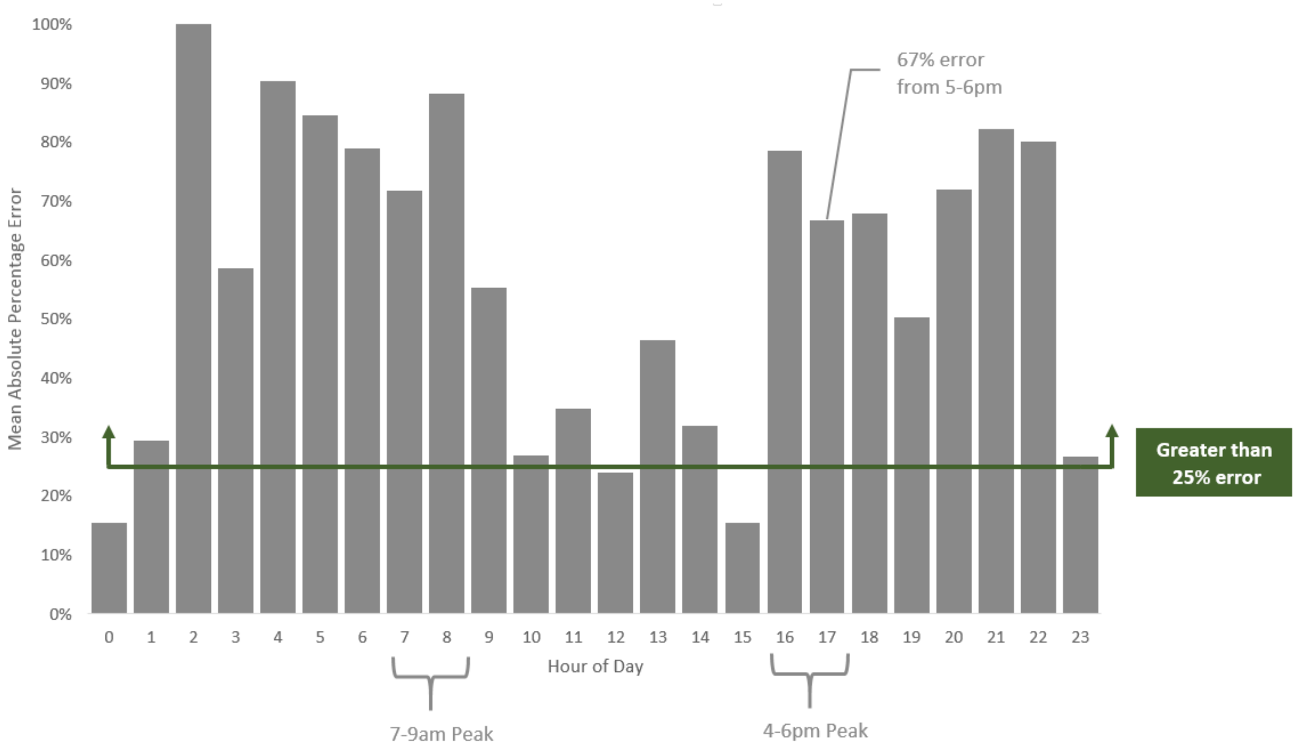
## Map 2. Regions in Washington State




At the time of this guide, no continuous count sites were located within the Coast Range or Cascades regions.

*Source: Authors' analysis of Nordback et al. 2017*

## Figure 6. Example of Error from Choosing Incorrect Factor Group




The figure above shows AADBT estimation error for Wednesday September 28, 2016 for the Apple Capitol Loop Trail (Eastern Washington, non-commute pattern). When the Fremont Bridge hourly factors from a different factor group (Puget Lowland, commute pattern) are applied to the Apple Capitol Loop data to estimate AADBT, this produces highly erroneous results. For this example, AADBT estimation error is greater than 25% for most hours of the day when the incorrect factor group is used, even at peak hours.

# Example of Applying Factors


## Step 1: Collect manual count data

Date: Wednesday, September 28, 2016
Site: Duwamish Trail and W Seattle Bridge Trail
Mode: Bicycle

| Date | Day of Week | Time | Count |
|---|---|---|---|
| Sept. 28, 2016 | Wednesday | 7-9am | **316** |
| | | 11am-1pm | - |
| | | 4-6pm | **335** |
| Oct. 1, 2016 | Saturday | 12-2pm | - |

*"-" denotes counts not available from WSBPDP*

## Step 2: Find appropriate adjustment factor

Reference Table 5 to find the adjustment factor for each of the recommended manual count periods for the appropriate factor group. For other years, reference the Appendix to learn more about calculating factors.

Factor group: Puget Lowland (region) - commute (travel pattern) - bicycle (mode)

| Date | Day of Week | Time | Adjustment Factor |
|---|---|---|---|
| Sept. 28, 2016 | Wednesday | 7-9am | **0.25** |
| | | 11am-1pm | - |
| | | 4-6pm | **0.20** |
| Oct. 1, 2016 | Saturday | 12-2pm | - |

*"-" denotes adjustment factors not available*

### Table 5. Adjustment Factors by Factor Group for Washington State, 2015-16

| | | Eastern Washington | | Puget Lowland | | | |
|---|---|---|---|---|---|---|---|
| | | Noon Activity | | Mixed | Noon Activity | | Commute |
| Date | Hour | Bicycle | Pedestrian | Bicycle | Bicycle | Pedestrian | Bicycle |
| Tuesday, 9/29/15 | 7-9am | - | - | - | 0.06 | - | 0.14 |
| | 4-6pm | - | - | - | 0.12 | - | 0.16 |
| Wednesday, 9/30/15 | 7-9am | - | - | - | 0.07 | - | 0.15 |
| | 4-6pm | - | - | - | 0.07 | - | 0.16 |
| Thursday, 10/1/15 | 7-9am | - | - | - | 0.07 | - | 0.14 |
| | 4-6pm | - | - | - | 0.12 | - | 0.16 |
| Tuesday, 9/27/16 | 7-9am | 0.15 | 0.03 | 0.10 | - | 0.18 | 0.26 |
| | 4-6pm | 0.19 | 0.16 | 0.16 | - | 0.33 | 0.21 |
| Wednesday, 9/28/16 | 7-9am | 0.07 | 0.08 | 0.10 | - | 0.07 | 0.25 |
| | 4-6pm | 0.23 | 0.10 | 0.17 | - | 0.12 | 0.20 |
| Thursday, 9/29/16 | 7-9am | 0.07 | 0.05 | 0.09 | - | 0.07 | 0.31 |
| | 4-6pm | 0.24 | 0.12 | 0.14 | - | 0.08 | 0.18 |

"-" denotes insufficient data to calculate factors. There were insufficient data for calculating factors for the Eastern Washington Commute (Pedestrian and Bicycle), Eastern Washington Multipurpose Bicycle, and Puget Lowland Commute Pedestrian factor groups. Factors were not calculated for the midday (11am-1pm TWorTh) and weekend (12-2pm Saturday) counts for 2015 and 2016 because the WSBPDP did not count during those time periods.

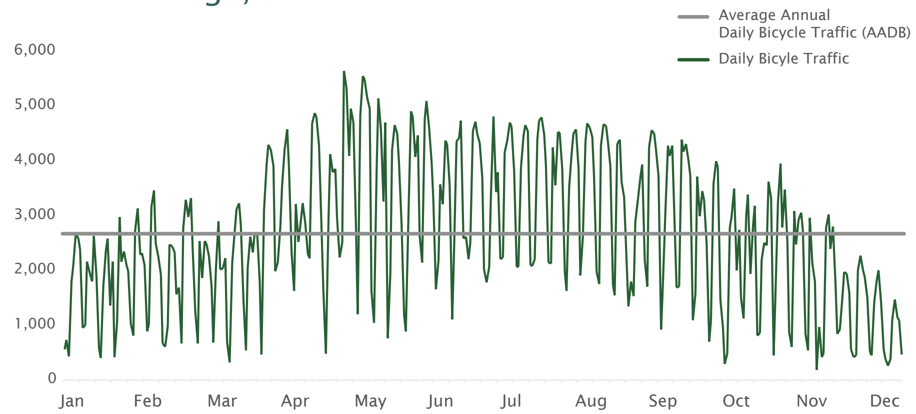
### Step 3: Apply the adjustment factor for each count period

$$\text{Estimated AADNT} = \frac{\text{Manual counts per hour}}{\text{Adjustment factor}}$$

After applying the adjustment factors, average the estimates for all available count periods.

| Date | Day of Week | Time | Manual Counts | Manual counts per hour | Adjustment Factor | Estimated AADBT |
|---|---|---|---|---|---|---|
| Sept. 28, 2016 | Wednesday | 7-9am | 316 | 158 | 0.25 | 600 |
| | | 11am-1pm | - | - | - | - |
| | | 4-6pm | 335 | 167.5 | 0.20 | 800 |
| Oct. 1, 2016 | Saturday | 12-2pm | - | - | - | - |
| | | | | | **Average Estimated AADBT** | **700** |

Figure 7. 2016 Daily Traffic Volumes and AADBT for the Fremont Bridge, Seattle




The raw, continuous data shows seasonal variation in daily bicycle traffic volumes. The average annual daily bicycle traffic (AADBT) represents the average of this seasonal variation including the highest volumes in the summer and lowest volumes in the winter.

*Source: Authors' analysis using data obtained from Seattle Department of Transportation via Eco-Visio, 2016*

# Expected Error

The estimated error based on a two-hour count alone is high. Overall there is about an 80% chance that the error will be within plus or minus 60%. To reduce error, make sure there is more than one continuous counter per factor group and collect more hours of short duration count data per site. The commute factor group and bicycle-only counts have the lowest error. Estimated error for the recommended 8 hours of manual counting is estimated to be between 30%  and 50% mean absolute percent error.

To reduce error:

- Count longer at each site. Increase the number of locations where at least one week of automated count data are collected. AADNT from one week is associated with error ranging from 10% to 30% mean absolute percent error (Nordback et al. 2013a; Nosal et al. 2014, Hankey et al. 2014).
- Install more than one continuous counter per factor group. Mean absolute percent error decreases over 50% for factor groups with two continuous counters rather than one. The TMG recommends 3-5 continuous counters per factor group, and research from Colorado indicates 7 per group may be optimal (Nordback et al. 2013b).

# Recommendations Summary

# Glossary and Acronyms

| | |
|---|---|
| ADT | Average Daily Traffic |
| AADT | Average Annual Daily Traffic |
| AADNT | Average Annual Daily Non-motorized Traffic |
| BMT | Bicycle Miles Traveled |
| FHWA | Federal Highway Administration |
| MUTCD | Manual on Uniform Traffic Control Devices |
| NBPDP | National Bicycle and Pedestrian Documentation Project |
| NCHRP | National Cooperative Highway Research Program |
| PMT | Pedestrian Miles Traveled |
| RCW | Revised Code of Washington |
| TMG | Traffic Monitoring Guide |
| TRB | Transportation Research Board |
| WSDOT | Washington State Department of Transportation |

**Automated Counts** - The collection of non-motorized traffic flow data using automatic counting equipment that continuously records data. Automated counts may be taken by permanent or portable/temporary counters.

**Annual Average Daily Traffic** - The total volume of traffic on a roadway for one year divided by 365 days. For non-motorized traffic this may be called AADNT or AADBT or AADPT.

**Bicycle** - Every device propelled solely by human power upon which a person or persons may ride, having two tandem wheels either of which is sixteen inches or more in diameter, or three wheels, any one of which is more than twenty inches in diameter. (Revised Code of Washington 46.04.071)

**Continuous** - Automated counters that collect data 24 hours a day, 7 days a week, 365 days a year and are typically permanently installed. There may be gaps in the data due to unanticipated weather impacts or equipment failure.

**Count Period** - A discrete time period in which counting takes place (e.g., 7:00-9:00am, 7:00am-7:00pm).

**Coverage Counts** - Counts collected across a wide geographic area.

**Crosswalk** - The portion of the roadway between the intersection area and a prolongation or connection of the farthest sidewalk line or in the event there are no sidewalks then between the intersection area and a line ten feet therefrom, except as modified by a marked crosswalk. (Revised Code of Washington 46.04.160)

**Factor Group** - Count sites grouped together by region, travel pattern, and mode for creating and applying adjustment factors.

**Intersection Counts** - Counts that are conducted where a non-motorized facility crosses another facility of interest (TMG, 2013)

**Manual Counts** - Counts that are conducted in-person by an observer or by analyzing video at screen line, intersection, or midblock locations. Data is generally tallied by hand on a paper schematic of a count location or using a handheld electronic count board.

**Morning Ratio** - The ratio of the peak weekend hour traffic to the peak weekday hour traffic.

**Network-wide Count Program** - A count program that measures travel over time across a network.

**Peak Volume** - The volume of traffic on a facility during the hour of the day that observes the highest traffic volumes for that given location.

**Pedestrian** - Any person who is afoot or who is using a wheelchair, a power wheelchair, or a means of conveyance propelled by human power other than a bicycle. (Revised Code of Washington 46.04.400)

**Project-Specific Counts** - Short duration counts collected for a special purpose related to a project, such as a before/after infrastructure improvement or a safety study.

**Screen Line Counts** - A screen line is an imaginary line that is drawn perpendicular to a facility of interest and traffic is counted as it crosses this line. Often, these spot counts are applied to the full segment length to calculate vehicle-miles traveled, pedestrian-miles traveled, and bicycle-miles traveled.

**Short Duration** - Counts conducted in a study area for less than one year either using manual or automated technologies.

**Sidewalk** - Property between the curb lines or the lateral lines of a roadway and the adjacent property, set aside and intended for the use of pedestrians or such portion of private property parallel and in proximity to a public highway and dedicated to use by pedestrians. (Revised Code of Washington 46.04.540)

**Traffic** - Includes pedestrians, ridden or herded animals, vehicles, streetcars, and other conveyances either singly or together, while using any public highways for purposes of travel. (Revised Code of Washington 46.04.590)

**Travel Pattern** - The variation in traffic volume over time of day, day of week, month of year, and season of the year.

**Vehicle** - Includes every device capable of being moved upon a public highway and in, upon, or by which any persons or property is or may be transported or drawn upon a public highway, including bicycles. "Vehicle" does not include power wheelchairs or devices other than bicycles moved by human or animal power or used exclusively upon stationary rails or tracks.

**Weekend Ratio** - The ratio of the weekday morning peak hour traffic and the weekday midday hour traffic.

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Pedestrian and Bicycle Information Center Image Library

Washington State Department of Transportation Flickr Account

# Appendix

## Calculating AADNT

*AADNT* = Annual average daily non-motorized traffic (includes bicyclists and pedestrians).

When separated by mode, AADNT is also called AADBT (bicycles) or AADPT (pedestrians)

$$\text{AADNT}y = \frac{1}{12}\sum_{m=1}^{12}\left[\frac{1}{7}\sum_{j=7}^{1}\left[\frac{1}{n}\sum_{i=1}^{n} V\,ijmy\right]\right]$$

*where:*
$m$ = the month of the year, $y$
$V$ = total traffic volume for $i^{th}$ occurrence of the $j^{th}$ day of the week within the $m^{th}$ month, for year $y$.
$n$ = the count of the number of $j$ days of the week during the $m^{th}$ month for which traffic volume is available (a number from 1 and 5)

To calculate AADNT:
1. Using continuous data from a given site for a whole calendar year (January-December), calculate the daily total count volumes for each day of the year (upto 366 values) by mode. Note, if bicycles and pedestrians are counted separately at a given site, compute AADBT and AADPT separately and do not combine the data. Exclude days with less than 23 hours of counts.

2. Average the daily total count volumes for each day of the week (Monday-Sunday) for each month. (7 values for each month)

3. Then average together each of the 7 day-of-week averages for each month. This results in the monthly average daily traffic (MADT) values (12 values).

4. Average the 12 MADT values to get the AADNT (1 value) for that given site.

This method is based on the American Association of State Highway and Transportation Officials (AASHTO) method for estimating AADT.

# Calculating Disaggregate Hour-of-Year Factors

There are several methods to calculate adjustment factors. This section discusses one method used, disaggregate hour-of-year factoring, which was used to calculate the 2015-2016 factors provided in Chapter 6. This is similar to the method used by Budowski (Budowski 2017).

The AADB estimation webpage discussed later explains a different factoring method using hour-of-day and month-and-day factors, starting on page 38.

Disaggregate hour-of-day factors represent a unique temporal state and this method inherently accounts for weather changes and variations from day-to-day and month-to-month. Therefore, hour-of-year factors can be applied directly to estimate AADNT without applying daily or monthly factors.

$$H_{h,j,y,k,s} = \frac{V_{h,j,y,k,s}}{AADNT_{y,k,s}}$$

*where:*
$H_{h,j,y,k,s}$ = Hourly factor for a given hour of the day, $h$, day of the year, $j$, year, $y$, mode, $k$, and site, $s$.
$V_{h,j,y,k,s}$ = Volume for a given hour of the day, $h$, day of the year, $j$, year, $y$, mode, $k$, and site, $s$.
$AADNT_{y,k,s}$ = Actual annual average daily bicyclists or pedestrians for year, $y$, mode, $k$, and site, $s$.

Group the sites by factor group. Average the hour-of-year factors for each factor group. Follow the steps in Chapter 6 to apply the factors to counts. The factor values in Table 5 are averaged over each two-hour time period (in other words, the factor for 7 to 8am is averaged with the factor for 8 to 9am).

## STANDARD SCREENLINE COUNT FORM

Name: ______________________ Location: ______________________

Date: ______________ Start Time: ______________ End Time: ______________

Weather: ______________

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

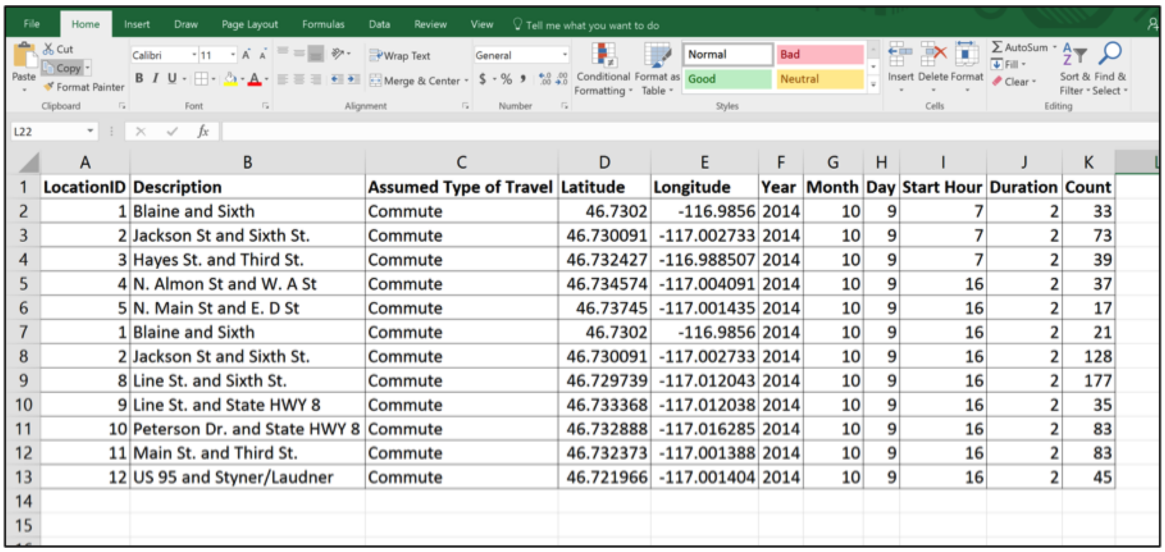
- Count for two hours in 15 minute increments.
- Count bicyclists who ride on the sidewalk.
- Count the number of people on the bicycle, not the number of bicycles.
- Pedestrians include people in wheelchairs or others using assistive devices, children in strollers, etc.
- People using equipment such as skateboards or rollerblades should be included in the "Other" category.

| | Bicycles | | Pedestrians | | Others |
|---|---|---|---|---|---|
| | Female | Male | Female | Male | |
| 00-:15 | | | | | |
| 15-:30 | | | | | |
| 30-:45 | | | | | |
| 45-1:00 | | | | | |
| 1:00-1:15 | | | | | |
| 1:15-1:30 | | | | | |
| 1:30-1:45 | | | | | |
| 1:45-2:00 | | | | | |
| Total | | | | | |

# Instructions for the AADB Estimation Webpage

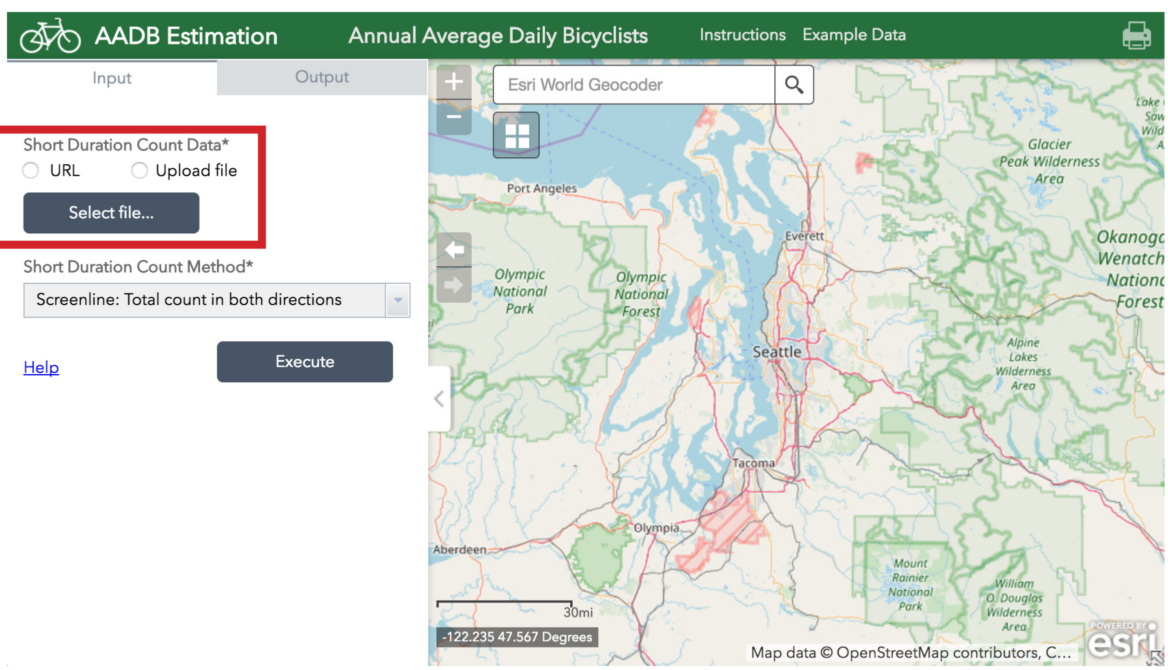
The AADB estimation webpage ( https://goo.gl/eRHG2q ) was created through grants from the Washington State Department of Transportation and US Department of Transportation. Results outside of Washington take longer to compute and are less reliable.

## Step 1. Create csv file for short duration count data

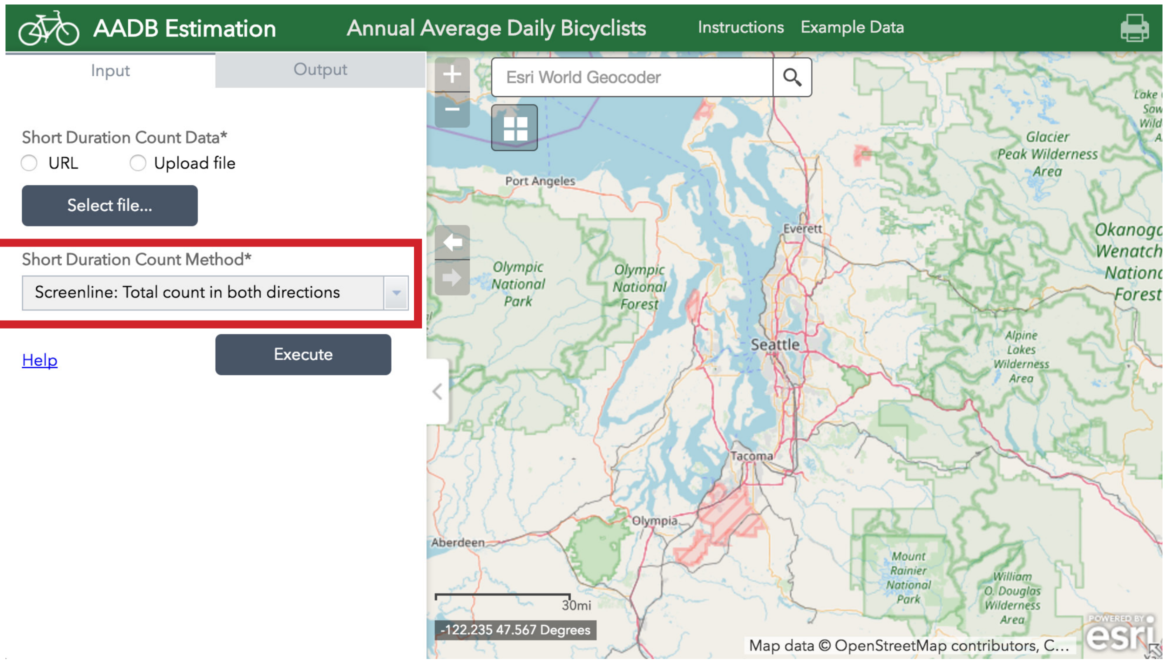


| LocationID | Description | Assumed Type of Travel | Latitude | Longitude | Year | Month | Day | Start Hour | Duration | Count |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Blaine and Sixth | Commute | 46.7302 | -116.9856 | 2014 | 10 | 9 | 7 | 2 | 33 |
| 2 | Jackson St and Sixth St. | Commute | 46.730091 | -117.002733 | 2014 | 10 | 9 | 7 | 2 | 73 |
| 3 | Hayes St. and Third St. | Commute | 46.732427 | -116.988507 | 2014 | 10 | 9 | 7 | 2 | 39 |
| 4 | N. Almon St and W. A St | Commute | 46.734574 | -117.004091 | 2014 | 10 | 9 | 16 | 2 | 37 |
| 5 | N. Main St and E. D St | Commute | 46.73745 | -117.001435 | 2014 | 10 | 9 | 16 | 2 | 17 |
| 1 | Blaine and Sixth | Commute | 46.7302 | -116.9856 | 2014 | 10 | 9 | 16 | 2 | 21 |
| 2 | Jackson St and Sixth St. | Commute | 46.730091 | -117.002733 | 2014 | 10 | 9 | 16 | 2 | 128 |
| 8 | Line St. and Sixth St. | Commute | 46.729739 | -117.012043 | 2014 | 10 | 9 | 16 | 2 | 177 |
| 9 | Line St. and State HWY 8 | Commute | 46.733368 | -117.012038 | 2014 | 10 | 9 | 16 | 2 | 35 |
| 10 | Peterson Dr. and State HWY 8 | Commute | 46.732888 | -117.016285 | 2014 | 10 | 9 | 16 | 2 | 83 |
| 11 | Main St. and Third St. | Commute | 46.732373 | -117.001388 | 2014 | 10 | 9 | 16 | 2 | 83 |
| 12 | US 95 and Styner/Laudner | Commute | 46.721966 | -117.001404 | 2014 | 10 | 9 | 16 | 2 | 45 |

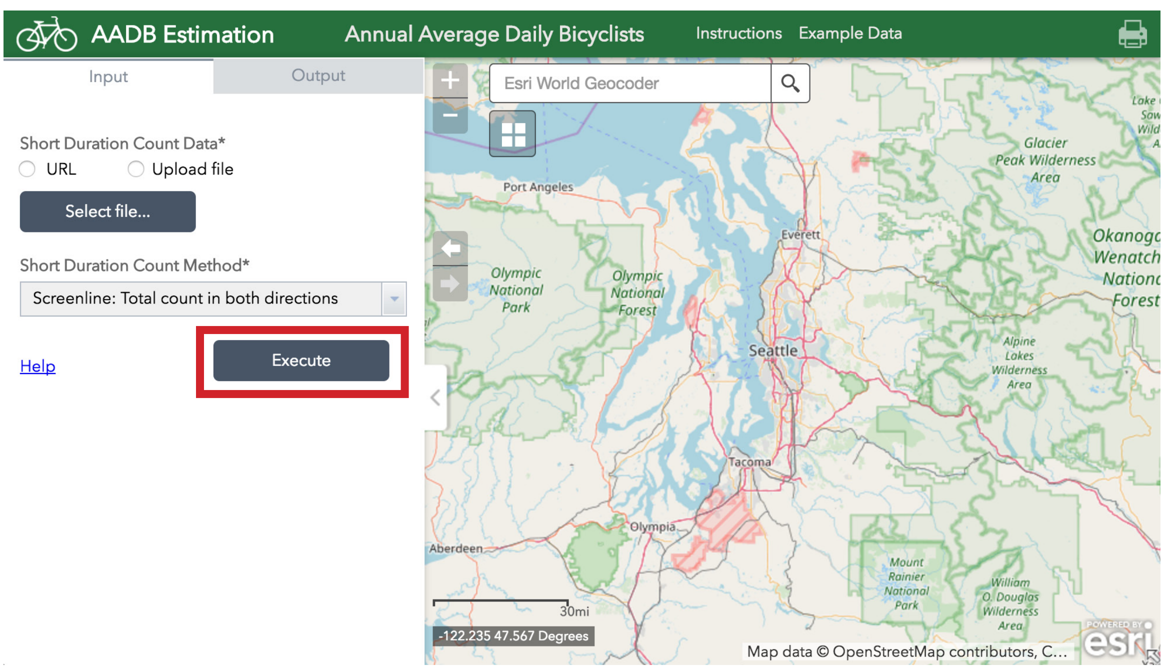
## Step 2. Upload csv (takes about 10 seconds)



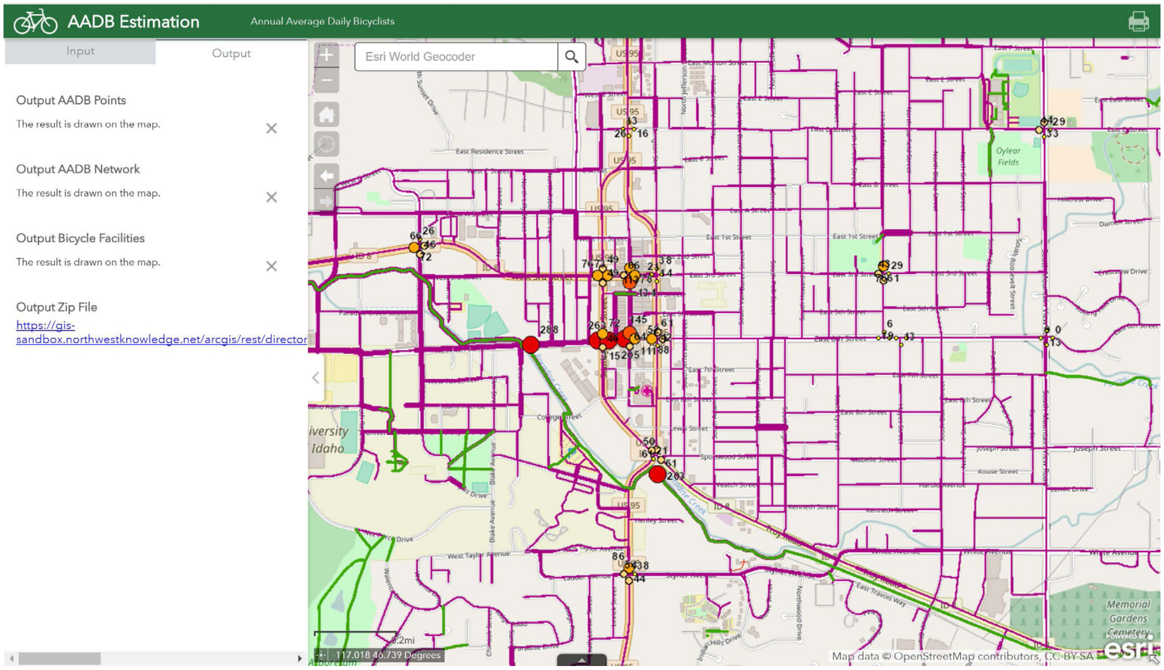
## Step 3. Indicate the count method: screenline or intersection



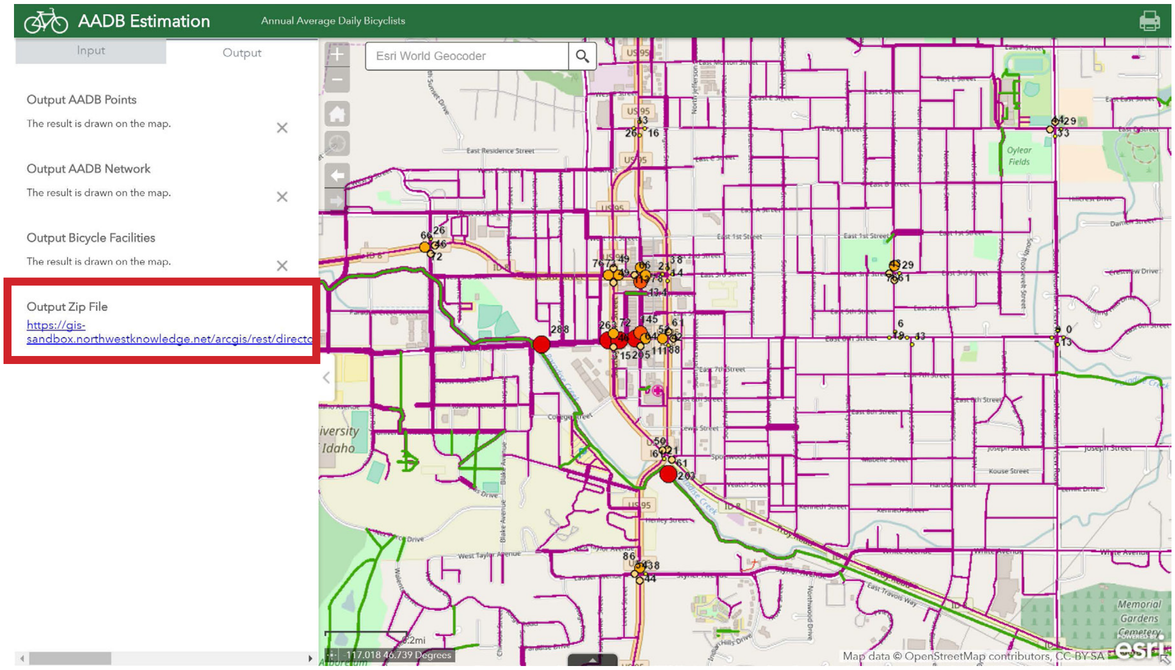

## Step 4. Click execute. Takes about 10 minutes for large cities (and at least four times longer for locations outside of Washington State)



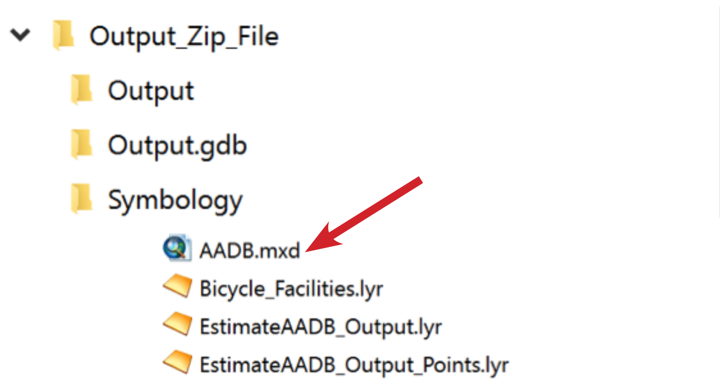
## Step 5. Explore output in the web map (zoom in to see volumes)



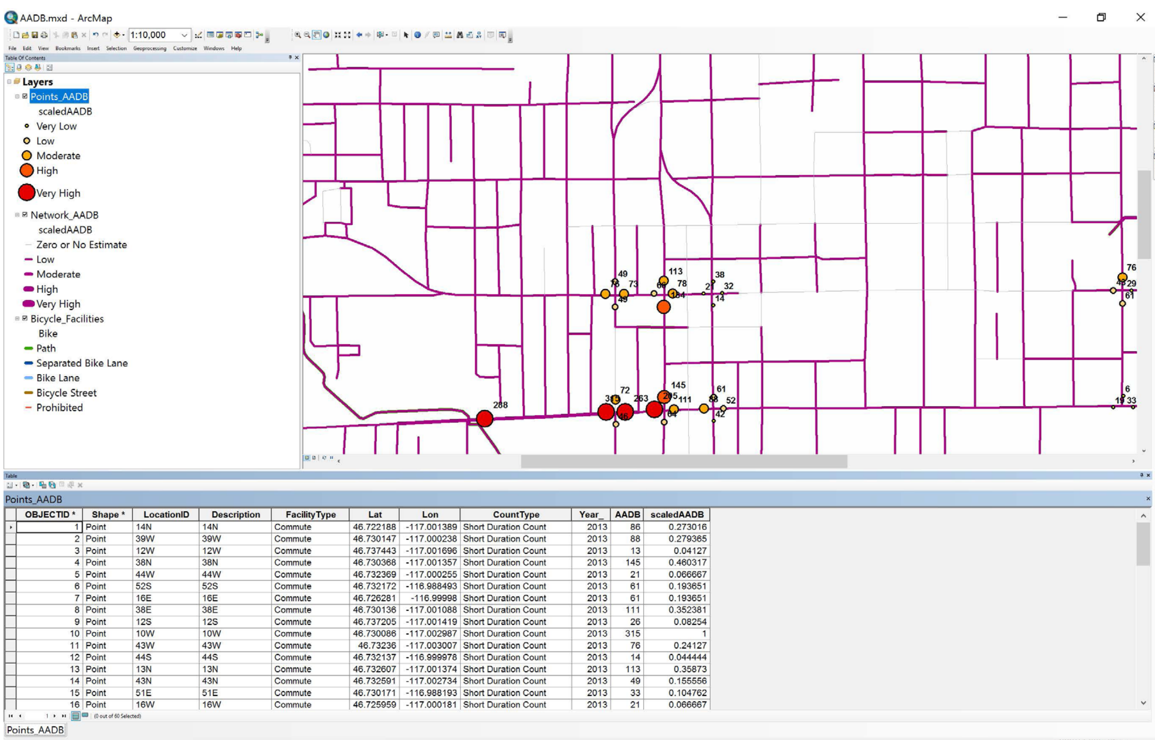

## Step 6. Download zip file



## Step 7. Unzip and open AADB map using ArcGIS




## Step 8. Explore attributes in ArcGIS

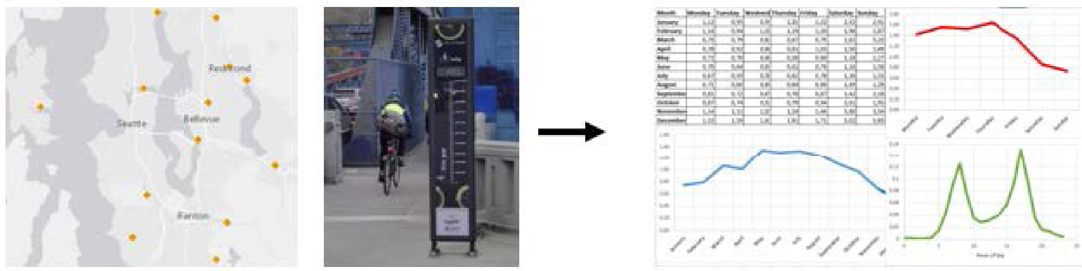



| OBJECTID * | Shape * | LocationID | Description | FacilityType | Lat | Lon | CountType | Year_ | AADB | scaledAADB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Point | 14N | 14N | Commute | 46.722188 | -117.001389 | Short Duration Count | 2013 | 86 | 0.273016 |
| 2 | Point | 39W | 39W | Commute | 46.730147 | -117.000238 | Short Duration Count | 2013 | 88 | 0.279365 |
| 3 | Point | 12W | 12W | Commute | 46.737443 | -117.001696 | Short Duration Count | 2013 | 13 | 0.04127 |
| 4 | Point | 38N | 38N | Commute | 46.730368 | -117.001357 | Short Duration Count | 2013 | 145 | 0.460317 |
| 5 | Point | 44W | 44W | Commute | 46.732369 | -117.000255 | Short Duration Count | 2013 | 21 | 0.066667 |
| 6 | Point | 52S | 52S | Commute | 46.732172 | -116.988493 | Short Duration Count | 2013 | 61 | 0.193651 |
| 7 | Point | 16E | 16E | Commute | 46.726281 | -116.99998 | Short Duration Count | 2013 | 61 | 0.193651 |
| 8 | Point | 38E | 38E | Commute | 46.730136 | -117.001088 | Short Duration Count | 2013 | 111 | 0.352381 |
| 9 | Point | 12S | 12S | Commute | 46.737205 | -117.001419 | Short Duration Count | 2013 | 26 | 0.08254 |
| 10 | Point | 10W | 10W | Commute | 46.730086 | -117.002987 | Short Duration Count | 2013 | 315 | 1 |
| 11 | Point | 43W | 43W | Commute | 46.73236 | -117.003007 | Short Duration Count | 2013 | 76 | 0.24127 |
| 12 | Point | 44S | 44S | Commute | 46.732137 | -116.999978 | Short Duration Count | 2013 | 14 | 0.044444 |
| 13 | Point | 13N | 13N | Commute | 46.732607 | -117.001374 | Short Duration Count | 2013 | 113 | 0.35873 |
| 14 | Point | 43N | 43N | Commute | 46.732591 | -117.002734 | Short Duration Count | 2013 | 49 | 0.155556 |
| 15 | Point | 51E | 51E | Commute | 46.730171 | -116.988193 | Short Duration Count | 2013 | 33 | 0.104762 |
| 16 | Point | 16W | 16W | Commute | 46.725959 | -117.000181 | Short Duration Count | 2013 | 21 | 0.066667 |

(0 out of 60 Selected)

## Explanation of the AADB Estimation Method

The AADB Estimation webpage includes a large database of adjustment factors that have been created from permanent continuous counting equipment.



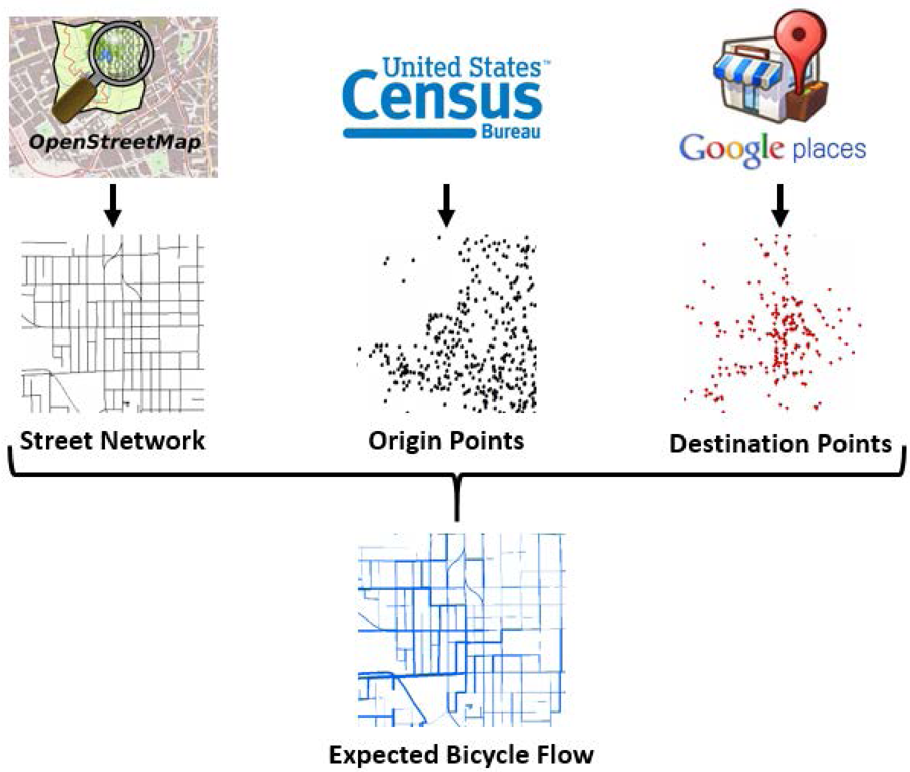
**Permanent Continuous Count Equipment** **Adjustment Factors**

A mathematical formula combines the short-duration count with a specific adjustment factor that matches the particular month, day, hour, and climate region of the short-duration count. The result is an estimate of Annual Average Daily Bicyclists (AADB) for each screenline location or Total Entering Bicyclists (TEB) for intersection locations. AADB is the total number of bicyclists traveling in both directions. TEB is the total number of bicyclists entering (or exiting) an intersection.

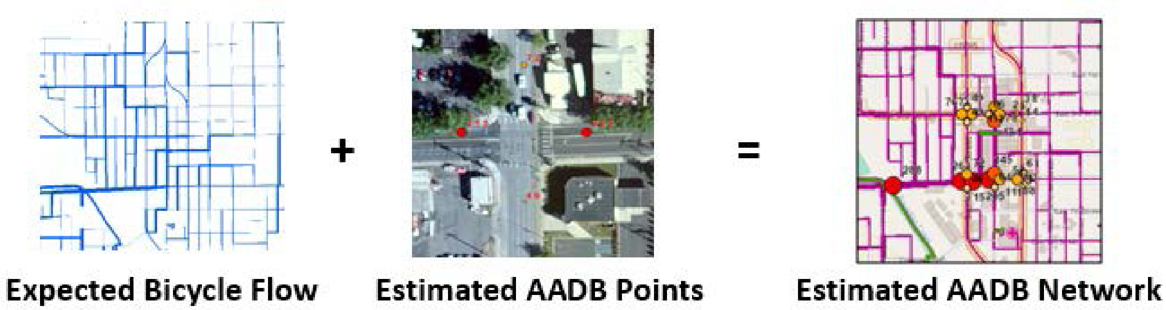

**Adjustment Factors** **Short-Duration Count** **Estimated AADB Points**

The AADB webpage creates a street network, origin points, and destination points for the study area. The street network is obtained from OpenStreetMap. The origin points are obtained from the US Census Bureau and are based on bicycle commuting statistics. The destination points are obtained from Google Places and include grocery stores, restaurants, schools, etc.

An expected bicycle "flow" is calculated for the network by finding the best bicycle route between origin and destination points. The routing is based on OpenStreetMap information such as presence of bike lanes and street classification.  Flow is the accumulation of thousands of potential trips that have been routed between every origin and every destination (and from every origin to every other origin and every destination to every other destination).




The expected bicycle flow is compared with the AADB points to determine a proportional relationship for the rest of the network.



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