Josue Hernandez-Rich City Rides

TRAILS COUNT!

Creating a Regional Program to Measure Trail Use in the Bay Area

A Report by the BAY AREA TRAILS COLLABORATIVE
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30 years
rails-to-trails conservancy

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A. Introduction – The Bay Area Trails Collaborative

This report is a product of the Bay Area Trails Collaborative (BATC), founded by Rails-to-Trails Conservancy (RTC) and the East Bay Regional Park District in June 2014. RTC serves as the organizer and convener, and Laura Cohen of RTC serves as chair. We have more than 40 public agencies and private organizations participating in the collaborative representing active transportation, recreation, public health, equity, private business and environmental sectors.

The purpose of the BATC is to complete, enhance and maintain an interconnected, world-class trail network in the San Francisco Bay Area that will improve our overall quality of life by: creating more opportunities for recreation and active transportation, improving public health, addressing health disparities in disadvantaged communities and promoting environmental sustainability. By working together as a powerful, multi-sector, regional collaborative, we can leverage our collective influence and expertise to advance policy and technical knowledge, increase funding and build a more diverse, robust trail movement in the Bay Area.

B. Overview – Purpose of This Report

Trails are vital community resources with the potential to transform cities and regions on many levels. As corridors for active transportation and recreation, a means to reduce greenhouse gas emissions and promote public health, and catalysts for economic development, more and more communities have discovered the tremendous value of trails. Yet, in sharp contrast to the abundance of data on motor vehicle use, we have sparse information about how many people are biking, walking and using trails, who they are, where they are going and why. This reflects transportation and land use policies of the last half century that have prioritized vehicle travel and neglected to invest in public transit, biking and walking. But the landscape is changing, as are our priorities and lifestyles. Bicycling and walking are on the rise, and trails are recognized as an integral part of the active-transportation and recreation networks that many local leaders now recognize as essential to a healthy, thriving community. The 2010-2012 California Household Travel Survey from the California Department of Transportation found that since 2000, the share of bicycling and walking trips in California had **doubled** from 9.2 percent to 18.1 percent of all trips.

Metrics matter. In the world of transportation, mode share and data on vehicle trips drive planning models, which drive policy priorities and funding. Performance metrics are also important to measure progress and answer questions like the following: When we build it, do they come? Are we investing in the right projects in the right places? Are our investments equitable?

In the past 25 years, there has been a shift toward planning for a multimodal transportation system, with more communities providing facilities to encourage safe bicycling and walking. Policies such as "complete streets" have become more mainstream. While many agencies have begun to count bicyclists and pedestrians along the street network to reflect this shift, trail-use counts have generally lagged behind; yet, trails form an integral component of local and regional transportation. For example, the San Francisco Bay Trail provides connections to dozens of business districts and schools across the nine-county Bay Area, and to the regional transit system, including BART, Caltrain and Amtrak stations, ferry terminals and major bus stops. There are an estimated 38 million trips on the Bay Trail each year, and this number is projected to exceed 70 million once the remaining segments are completed. As trails come to be understood not only as recreational facilities but as key pieces of the transportation system—for commuting, shopping, recreation and trips to school—collecting trail-use data becomes increasingly important as a planning tool.

In an effort to enhance trail planning practices across the region, create a foundation for project performance metrics and provide a regional picture of trail use, the Bay Area Trails Collaborative is seeking to expand trail count efforts and explore strategies to share data among agencies and organizations that plan, manage and advocate for trails. In this paper we have documented:

1) the range of available data collection methods;

2) trail-count practices among Bay Area agencies;

3) best practices based on these efforts and others around the country, so that other Bay Area agencies can learn from this experience;

4) national examples of regional bicycle and pedestrian data-sharing platforms to help paint a regional picture of trail use; and

5) recommendations to create a robust Bay Area-wide bicycle/pedestrian/trail count program that could serve as a model for other regions.

C. Purpose of Trail Counts

Why count trail traffic or use? Trail-count data can help us understand and improve the Bay Area trail network in several key ways:

1) **Funding** – For agencies seeking grant funding for trail projects, demonstrating the level of potential use is one of the critical pieces of information needed to make the case for a project, and it is frequently required for grant applications. Data can demonstrate not only the number of trail trips but trip purpose (transportation vs. recreation), especially critical in making the case for funding from federal, state and local funding sources. For corridors where new trails are proposed, data from existing trails can provide empirically based support for estimates of future trail users.

2) **Demonstrate the value of trails** – Assessing the value of trails is critical for ensuring that local public officials continue to steer public investment into the construction, operations and maintenance of trails. Where data has been collected, it has demonstrated the power of trails as an economic driver[1] or as a commuter route.[2] Used more broadly, trail counts are an important way to generate support for trails from elected officials, transportation professionals, economic development and public health interests and the general public.

3) **Performance metrics** – Trail-count data will establish baseline trail-usage levels, demonstrating changes in usage patterns over time and enabling jurisdictions to evaluate the effectiveness of their trail investments. For example, these metrics can also illustrate how the expansion of the regional trail network increases overall connectivity and generates more biking and walking. The data can also be used to inform trail management, including how to address issues such as intersection controls, modal conflicts between users, hours of operation and seasonal maintenance.

4) **Prioritize projects** – Local and regional bicycle and pedestrian plans rely on many factors to prioritize projects for implementation. The historical lack of bicycle and pedestrian data has often resulted in underinvestment in these modes, despite the fact that bicycle/pedestrian infrastructure investment is one of the most cost-effective strategies for improving mobility and public health while reducing air pollution and greenhouse gas emissions. Looking at construction costs alone, a mile of a four-lane urban highway costs at least $20 million to $80 million, and often more, while a mile of bicycle and pedestrian infrastructure can cost as little as a few thousand dollars and rarely more than $1 million.[3] The U.S. Department of Transportation has recognized the importance of collecting data on bicycle and pedestrian travel to guide project development, recommending in its *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations* that communities establish "routine collection of non-motorized trip information. Communities that routinely collect walking and bicycling data are able to track trends and prioritize investments to ensure the success of new facilities."[4]

5) **Demonstrate effectiveness of government funding** – Federal and state funding programs have been establishing increasingly rigorous criteria for evaluating their funded projects, with a growing reliance on quantitative data.

6) **Input into travel demand models** – Bicycle and pedestrian count data are being used in some locations to help develop bicycle and pedestrian mode-share estimates through their travel demand models. Counts from both on-street and off-street facilities can supply important data to develop forecasts of future use and to validate the models as they become increasingly sophisticated.

Bicyclists along the Richmond Greenway in Richmond, California.

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[1] *Trail User Surveys and Economic Impact*, Rails-to-Trails Conservancy, 2009. http://www.railstotrails.org/resourcehandler.ashx?id=3589
[2] *Trail Count 2015*, City of San Jose, http://www.sanjoseca.gov/DocumentCenter/View/47022
[3] *Active Transportation for America*, Rails-to-Trails Conservancy, 2008. https://www.railstotrails.org/resourcehandler.ashx?id=2948
[4] http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance policy_accom.cfm

D. Trail-Count Methodologies and Technologies

Once an agency has decided to conduct trail counts, there are several approaches and technologies to choose from. The discussion below provides an overview of the count methods that are currently in use in the Bay Area, and a description of those practices. The full range of technological approaches to conducting counts is described in numerous reports, which are cited in the reference section at the end of this report.

What is the best trail count approach?

There are many approaches to collecting trail counts, and choosing the best method for a particular situation should be guided by a number of factors, including the following:

- What do you wish to count? Bicyclists? Pedestrians? Both?
- What details do you wish to know about users? Gender? Age? Helmet use? Trip purpose?
- Do you want to know the direction of travel?
- What time frame? Time of day? Day of week? Time of year?
- What are the characteristics of the site? Does it preclude installing certain types of devices?
- What is your annual budget for equipment, software and staff to maintain and monitor it?
- What level of reliability and accuracy will meet your needs and your budget?

There are two basic approaches to collecting trail counts: automated and manual counts. Each approach is better suited to collect different types of data, as discussed below. Their approaches are not mutually exclusive and in some cases can be employed along the same trail to collect complementary data. This discussion focuses on the primary methods and technologies used by Bay Area agencies.

Automated count technologies: Automated counters are used to collect data 24 hours a day, seven days a week. For some technologies, the data collection period can vary from days to months to years. The Federal Highway Administration has recommended that automated bicycle and pedestrian counters be installed for at least seven days to account for variation in counts across days of the week.[5] Counters that are deployed for long periods of time can help capture the impact of seasonal variations on trail use.

There are numerous technologies available to conduct automated bicycle and pedestrian counts, and additional ones are under development. A summary of these technologies, and advantages and disadvantages of each, are provided in Appendix A. For a detailed discussion of these technologies, see the citations and links to numerous reports at the end of this paper.

In the Bay Area, we have identified two types of automated counters that are being used on trails. The description below applies to trail counters used by Bay Area agencies, although there are other manufacturers of these types of devices. We have also included a brief review of piezoelectric strips, an emerging technology that offers promise for counting bicyclists and pedestrians along trails.

Passive infrared – Passive infrared counters count bicyclists and pedestrians through a sensor that detects the body temperature of users within the range of the sensor. For mobile applications, the counters can be placed in a locked metal box and mounted on a pole or fence. The counters can also be permanently mounted inside a wooden post. Most Bay Area agencies conducting automated counts have selected passive infrared counters manufactured by Eco-Counter, which, as stand-alone devices, are able to detect the user's direction of travel but can not differentiate between bicyclists and pedestrians.

A biker passes a short-duration count station with a passive infrared counter and pneumatic tubes.

[5] Traffic Monitoring Guide, Federal Highway Administration, 2013. https://www.fhwa.dot.gov/policyinformation/tmguide/

There is an option for a modem-equipped version to enable remote data downloading. This is advantageous because it provides real-time count data and enables agency staff to easily determine if a counter is continuing to operate and collect data, thereby significantly reducing the need for staff time in the field. The primary weaknesses of passive infrared counters are that they have difficulty accurately counting pedestrians in groups (they cannot distinguish the heat signature of people walking close to one another) and fast-traveling bicyclists.

Ground sensors – Ground sensors offer another technology option for counting trail users, but they can only detect bicycles, not pedestrians. As a result, they are typically used in tandem with an infrared counter, although they work effectively on bicycle-only facilities such as separated bikeways (a.k.a. cycle tracks). Inductive loops, which are also used to detect vehicles at many traffic signals, are permanent ground sensors installed under a paved or unpaved trail surface that register users by detecting the metal in the bicycle. Alternatively, pneumatic tubes are well suited to short-duration counts, as they are installed on top of a trail surface and can be easily moved between locations. Pneumatic tubes count bicycles by using an air switch to detect a short burst of air from a passing bicyclist. They also have the advantage of being much less expensive than inductive loops. However, if used on roadways, the tubes are easily damaged by passing cars and trucks.

This permanent count station features a passive infrared counter housed in a wooden post and diamond-shaped inductive loops installed beneath an asphalt trail.

As noted above, ground sensors are frequently paired with infrared counters so bicyclists and pedestrians can be counted separately. Since the infrared counter collects the total number of passersby, the number of bicyclists detected by the ground sensor can be subtracted from the total to calculate the number of pedestrians. At permanent count stations, durable installations are often used, such as the post-mounted passive infrared counter described above, in conjunction with an inductive loop. This combination—the version manufactured by Eco-Counter known as the Eco-Multi—has become the preferred choice by many Bay Area agencies for permanent counter installations.

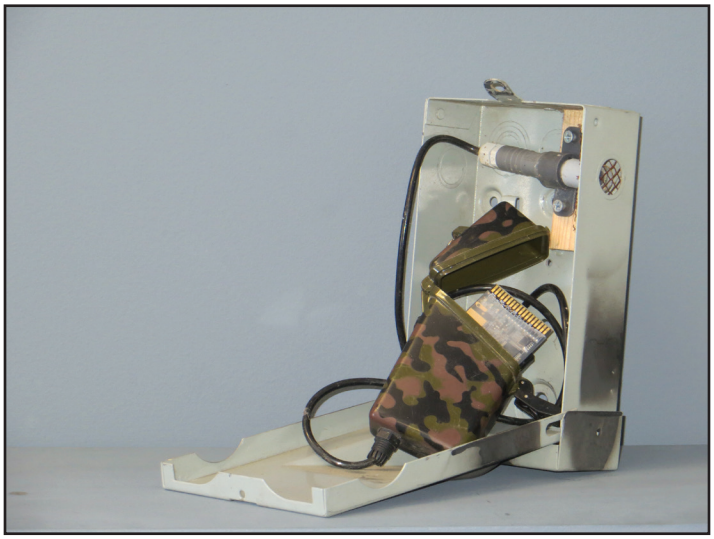
Piezoelectric strips – Piezoelectric strips are another count technology that, although widely used on trails in Australia, is still uncommon in the U.S. The counters detect bicyclists using two metal strips that are embedded in the pavement across a trail or roadway. A bicycle passing over the strips applies pressure to the strips, which emit an electric signal, triggering a data logger. While pedestrians, wheelchairs and skateboards can also apply pressure to generate the electrical signal, the software can differentiate between the various user types. In addition, this technology has the capability to detect side-by-side bicyclists, direction of travel and speed.

As with inductive loops, piezoelectric strips can only be used for permanent count locations. While the hardware is inexpensive, they need to be installed below the pavement surface, so the initial costs are relatively high. By pairing piezoelectric strips with infrared counters, both bicyclists and pedestrians can be detected at the count site.

Manual counts: Manual trail counts are collected by individuals at a particular location by recording the number of trail users that pass by that point. The most widely accepted methodology for conducting manual bicycle and pedestrian counts was developed by the National Bicycle and Pedestrian Documentation Project (NBPD), an effort co-sponsored by Alta Planning and Design and the Institute of Transportation Engineers (ITE) Pedestrian and Bicycle Council. With the intent of developing a guideline for Bay Area agencies for collecting manual bicycle and pedestrian counts, the Metropolitan Transportation Commission (MTC) has adopted the NBPD methodology.

The NBPD methodology aims for consistency to help create a national picture of bicycle and pedestrian travel. NBPD asks that participating agencies conduct their counts during the designated national count week, the second week in September. Agencies are asked to select a Tuesday, Wednesday or Thursday, and a Saturday following or preceding the count week. Recommended times are from 5 to 7 p.m. on weekdays (to correspond with peak travel times) and noon to 2 p.m. on Saturdays to target recreational users. Secondary times are 7 a.m. to 7 p.m. for both weekdays and weekends. NBPD has also established optional count dates in January, May and

July. NBPD has developed adjustment factors to extrapolate short-term manual counts to estimate daily, monthly and annual use, accounting for variation by time of day, day of the week, season and climate. However, the limitation of the extrapolation methodology should be recognized, as it was intended to provide estimates on a national or regional scale, not for specific facilities. Information about the NBPD methodology, including detailed data collection instructions, forms and tools for extrapolating count data to estimate annual trail usage, can be downloaded at **bikepeddocumentation.org**. To assist with data collection, RTC has produced an app called GoCounter, which is available for iPhone and Android phones.
More information about GoCounter is available at **railstotrails.org/gocounter.**



This is a close-up of an infrared counter.

The installation of an infrared counter in the field.

Implementing a manual count effort requires significant coordination and is quite resource intensive, requiring thorough planning, design of the count deployment and collection maps and forms, support during the count periods and follow-up to check the data collected. As a result, for large-scale count efforts, staff resources are often supplemented with assistance from volunteers or consultants. Volunteers have been used extensively by the Los Angeles County Bicycle Coalition, which has conducted counts at more than 100 locations involving more than 400 volunteer shifts. However, a challenge with this approach is maintaining data quality; data collectors should be carefully trained to maximize consistency of the data. Aside from helping defray some of the costs associated with collecting manual count data, volunteer participation also offers an additional benefit, as their active involvement helps cultivate community support for trails.

Manual counts provide valuable data demonstrating trail use and user characteristics. However, NBPD recommends that agencies conduct these counts in conjunction with automated counts to provide a more comprehensive picture of trail use. Used independently, manual counts track bicycle and pedestrian travel in a very limited time frame and do not account for various factors that impact trail use patterns, as described above. However, one side benefit of manual counts is that they provide an additional opportunity to enhance the data. In particular, count sites can also be used as stations to collect user surveys. The City of San Jose has adopted this strategy, which has enabled them to collect a richer set of trail use data. The use of such surveys is discussed later in this paper.

A volunteer collects data during San Jose's annual trail user count and survey.

E. Bay Area and National Trail Count Practices

Many Bay Area agencies collect bicycle and pedestrian intersection data as required for the county Congestion Management Program, but this does not generally include data from trails. However, we found a broad range of agencies and organizations in the Bay Area with an interest in documenting trail use, including agencies that help fund trail development, trail managers and trail advocates. We contacted staff at a variety of agencies responsible for planning and for managing trails to determine whether they conduct trail use counts and the methodologies used. As we did not have the resources to conduct a comprehensive survey of all Bay Area jurisdictions given the size of the region, we focused on regional and county agencies, agencies managing trails in parks and selected jurisdictions.

Trail data collection across the region is relatively limited, and most of the counting efforts have been introduced within the past 5–10 years. The trend has been for agencies to purchase automated counters, in particular the two Eco-Counter models described above. In each of the jurisdictions we contacted that have not collected trail-count data, staff expressed a strong interest in collecting this information to strengthen their planning efforts but typically noted that they had insufficient resources to do so.

Table 1 summarizes the trail-use counting practices of as many agencies as we could identify with such programs. Large park agencies and county planning agencies have been driving Bay Area efforts toward using automated counters. The majority of the counters have been purchased within the past five years, and the passive infrared Eco-Counters—both permanent and mobile—have become the preferred counter among the agencies surveyed. A growing number of communities across the country have also developed counting programs with automated counters. Most recently, some of these agencies have been working to utilize this data not only to track performance, but to develop the next generation of trail planning tools, as described below.

While most Bay Area agencies have conducted their trail counts with automated counters, others—including the City of San Jose, as noted above—conduct annual manual counts. As noted previously, while these methods collect data during a more limited time period, they capture more fine-grained data than is possible with automated counters.

Nearly 100 communities across the country participate in the annual counts for the NBPD project, with more than 600 data collection sites, though only some are on trails. The total is likely higher as many agencies may not upload their data to the NBPD website. One of the largest trail-count efforts in the country using manual counts is conducted by Portland Metro, the regional planning organization in Portland, Oregon. In 2013 Metro partnered with 20 cities and agencies, utilizing 100 volunteers, to collect data at 109 sites.

Table 1: Bay Area Agency Trail Count Practices

Jurisdiction/Agency	Count Method	Number of Counters (if applicable)	Counter Type (if applicable)
City of San Jose	Manual	N/A	N/A
Alameda County Transportation Commission	Automated	2*	Passive infared
Solano County Transportation Authority	Automated	4*	Passive infrared with pneumatic tubes
Sonoma County Transportation Authority	Automated	4*	Passive infrared with pneumatic tubes
Golden Gate National Parks Conservancy	Automated	13	8 passive infrared with inductive loops, 5 passive infrared only
Presidio Trust	Automated	18	10 passive infrared only, 8 passive infrared with inductive loops
Marin County Public Works	Automated and Manual	4	2 passive infrared with inductive loops, 2 passive infrared only
East Bay Regional Park District	Automated	55	51 passive infrared only, 4 passive infrared with inductive loops

* Counters are mobile and are used for trails as well as bicycle/pedestrian counts in on-street environments.

F. Complementing Count Data: Surveys and Crowdsourcing

In addition to collecting data through automated counters and live manual counts, there are other strategies that can supplement count data and contribute to a deeper and more complete understanding of trail users, including trail-user surveys and data from mobile applications, also known as "crowdsourcing."

Surveys: Trail-user surveys can collect data not available through manual or automated counting. This may include demographic data, trip origin, destination, duration and purpose, and economic impacts. Since surveys are conducted at very few sites along a trail, they can also provide insight into which sections of the trail are most popular. Surveys can be implemented in several ways: 1) mail-back or drop-box, 2) intercept interviews, or 3) online.

Mail-back or drop-box: Mail-back surveys can be made available at trailheads or through trailside businesses. The survey forms include prepaid postage so respondents can complete the survey forms and return them at no charge. Drop-box surveys are administered similarly, but the forms are deposited in a box at the trailhead or business where they are distributed.

Intercept: Surveys can be implemented as "intercept" surveys in which interviewers stop trail users and ask them a series of questions. This method can be labor intensive, especially on less frequently used trails where a significant amount of time may be required to obtain a useful sample of surveys, and can only be completed during a relatively short time frame.

Online: Thanks to online tools, web-based surveys can be easily set up to collect trail user survey data. Potential respondents can be provided with links to the survey through distribution of cards or through messages distributed through partner email lists. These surveys enable the collection of data and easy analysis—the capabilities vary depending on the survey tool being used—without having to manually enter survey responses.

Each of these methods has their advantages and disadvantages. For more labor-intensive approaches, surveys can be implemented more efficiently by conducting them concurrently with manual counts. As with manual counts, using volunteers can significantly reduce the cost of collecting this type of data, though careful training of volunteers is critical to ensure consistent surveying techniques and data quality. Survey forms or cards with links to web-based surveys can be distributed to trail users at count stations, reducing the number of people required to conduct these efforts and avoiding confusion among trail users by not having multiple data collection efforts along a trail. RTC has produced a guidebook for developing and implementing trail surveys, available at **railstotrails.org/TUSworkbook**.

Crowdsourcing with mobile apps: A number of agencies across the country are beginning to supplement their trail counts with crowdsourced data, which takes advantage of the widespread use of fitness-oriented mobile applications (apps) used on smart phones. Relying on GPS, these apps track movements of individual users and enable the compilation of new datasets by aggregating bicycling, walking, running and other types of trips. Practitioners are working to develop the most appropriate methods to incorporate crowdsourced data into their planning and implementation of bicycle and pedestrian facilities, including trails. Strava, RunKeeper and MapMyRide/Run/Hike are among the most popular crowdsourcing apps. The San Francisco County Transportation Authority (SCTA) has developed a similar app called CycleTracks, which a number of cities across the country have adapted for their own use.

The benefit of crowdsourced data is that it provides a detailed profile of users, as the apps can collect data that would not be available from automated counters or through manual counts; this includes gender, age, cycling/running/hiking frequency, trip origins and destinations, trip routes, preferred routes/trails and speed traveled. For trails, potential uses include analyzing usage along an entire trail network continuously throughout the entire year as well as identifying common entry and exit points on a trail. Strava's Global Heat Map (**labs.strava.com/heatmap/#10/-122.28441/37.69428/blue/bike**, see screen shot in Appendix B) provides a look at this data and reveals that trails are some of the most popular routes in the Bay Area for Strava users.

The Golden Gate National Parks Conservancy counted more than 1.1 million trail users along this stretch of the San Francisco Bay Trail from March-December in 2015.

Limitations of Survey and Crowdsourced Data

Survey and crowdsourced data offer more fine-grained and therefore complementary data to counts collected by automated counters and manual surveys. The major limitation of both survey and crowdsourced data is that the data is collected from a self-selected group of bicyclists and pedestrians—those who choose to complete a survey or use an app—and do not reflect a representative cross section of all users. When determining how to best use this data to support trails, it will be important to consider which segments of the population the respondents represent and the types of trips users tend to record with their apps. For example, the Strava heat map for the Bay Area shows a bias toward recreational trips; in Oakland it indicates significantly more trips along scenic routes in the hills than on major arterials and streets in commercial areas.

Agencies seeking to use these types of data will also need to consider the resources needed for the data collection. Surveys can require significant resources to implement, depending on the methodology used, to the degree that they require training interviewers, stationing interviewers in the field (unless they are volunteers) and data entry; they are more labor intensive and more expensive. Web-based surveys and crowdsourced trail user data also include some costs (particularly for agencies purchasing data from private companies) but can potentially provide much larger data sets.

Photo courtesy www.pedbikeimages.com | Dan Burden

G. Utilizing Trail Counts With the Next Generation of Planning Tools

In 2014, RTC launched a major national initiative to develop the next generation of cutting-edge trail planning tools known as the Trail Modeling and Assessment Platform (T-MAP). T-MAP promises to transform how agencies and decision-makers plan and fund trails, and to understand the impact that trails have on communities. RTC is partnering with 14 cities across the country to collect data at 50 sites to develop these tools, which will enable agencies to forecast trail use along future trail corridors, evaluate the impact of interconnected facilities and estimate the value of trails for health and transportation. Using the outputs of this analysis, trail planners will be able to make the same type of data-driven decisions that have long been used to plan roadway networks, a critical step in demonstrating the value of trails and enabling them to compete for scarce resources. Trail-count data will be required inputs for such planning tools, so the more that Bay Area agencies can employ the best trail-count practices, the more accurate and valuable the model outputs will be. The initial deployment of T-MAP is scheduled for 2016. Additional information about this project is available on RTC's website at **railstotrails.org/TMAP**.

H. Sharing Data With Practitioners and the Public

While collecting trail-use data clearly benefits the jurisdiction where the trail is located, creating a central repository for trail data from across the Bay Area offers the potential to provide a regional picture of trail use, and provide local planners, advocates and policy makers with a rich storehouse of data they can use to prioritize and make the case for trail investment in their jurisdictions. Several agencies across the country have developed models for compiling, displaying and sharing data through interactive websites. Below, we highlight three examples that can inform the process of developing a system customized for the Bay Area's unique needs. The sponsoring agencies for these three efforts have developed websites where the public can view bicycle and pedestrian count data, including data from trails, collected at locations across their respective jurisdictions. These locations include trails as well as streets and sidewalks. While these websites include many common features, they each include some unique elements as described below.

1) **Delaware Valley Regional Planning Commission (DVRPC)**, the regional planning organization for the Philadelphia metropolitan area, displays data from 150 bicycle and pedestrian count sites across their nine counties in Pennsylvania and New Jersey (**dvrpc.org/webmaps/pedbikecounts**). They rely primarily on mobile passive infrared counters, which are deployed for seven to nine days each, with data collected on a three-year cycle.

DVRPC has also installed nine permanent counters—with plans to install 10 more—which are used to calibrate the counters deployed at the other locations.

2) **Southern California Association of Governments (SCAG) and Los Angeles Metro** in the Los Angeles area, in partnership with the University of California Los Angeles, have developed their Bike Count Data Clearinghouse (**bikecounts.luskin.ucla.edu**) to compile data from more than 800 sites. While the current data collection sites are all located in Los Angeles County, the site will ultimately be expanded to include other SCAG jurisdictions. Manual count data is collected by local jurisdictions using a methodology and materials provided by SCAG and Metro. The counts are then uploaded to the website and made available to the public. SCAG is in the process of upgrading the functionality and interface of its website, which will be designed to incorporate pedestrian data and potentially automated counter data.

3) The **City of Arlington**, Virginia, has developed a similar website at the local level: (**bikearlington.com/pages/biking-in-arlington/counting-bikes-to-plan-for-bikes/about-the-counters**). The city has installed 32 permanent count stations and also has six mobile counters. Arlington's website is particularly noteworthy in that it provides daily updates of counts for each counter in their network. The site also contains options for sorting the data based on several factors, including weather and temperature on a specific data collection date.

Screen shots of each site are included in Appendix C.


Photo by Noah Berger courtesy of MTC

I. Key Lessons Learned

Through our research and interviews with Bay Area agency staff, there were several important aspects of existing count practices and agency data needs that can help guide the development of a Bay Area-wide bicycle/pedestrian/trail count program.

Automated and Manual Counts – As the range of data collection practices indicates, there is no "one size fits all" approach to collecting trail-use data. The key to determining the most appropriate strategy is for each agency to articulate its objectives and identify available resources, as discussed in Section D above.

Several of the agencies surveyed and others from outside the Bay Area have demonstrated that there is considerable value in deploying two or more strategies to complement each other. For example, automated counter data, manual counts and surveys could all be conducted on the same trail segments. This would provide a richer picture of trail use, as each approach is better suited to collecting a particular type of data. Data collected through manual counts can also reveal patterns that can be extrapolated to help develop a picture of user characteristics for similar trails.

Multiple Types of Automated Count Equipment – While some agencies have relied exclusively on one model of counter, others have developed programs utilizing both mobile and permanent counter stations. While permanent count stations may be the clear choice for collecting data at key locations in the trail network, including mobile counters as part of a count program allows for data collection at more sites, creating additional flexibility and helping maximize the efficient use of limited resources. The permanent count stations can also help develop customized adjustment factors for short-duration trail counts, accounting for daily, weekly, monthly and seasonal variations to develop annual trail-use projections.

Shared Counters Among Agencies – Several staff at Bay Area agencies expressed an interest in collecting trail-count data but have been unable to do so due to lack of funding. The Sonoma County Transportation Authority and Solano County Transportation Authority have implemented a strategy to increase the local capacity to conduct this work, purchasing counters to conduct bicycle and pedestrian counts but also making them available for loan to local jurisdictions in their area. To help ensure that high-quality data is collected, local agency staff has been trained to install the counters and upload the data they have collected.

Shared Data Among Agencies and the Public – BATC partners have indicated their interest in having an easily accessible source of bicycle and pedestrian counts from a variety of locations across the region to help understand broader usage patterns and the potential value of future projects. Web-based data sharing has been successfully implemented in other

regions, as described above. A key consideration for the Bay Area will be to determine how to compile data collected by local agencies that may use different counting technologies and methods.

J. Recommendations

There is clearly a growing trend across the Bay Area toward collecting more robust trail usage data to better understand active transportation and recreation. The BATC seeks to build on this trend with a regional approach to developing data-collection best practices, data sharing and the incorporation of this data into planning efforts. To this end, the Collaborative will pursue the following recommendations, in coordination with MTC and local agencies:

- **Develop a comprehensive regional bike/ped data program:** We recommend that MTC—as the regional transportation planning agency for the Bay Area—create a comprehensive regional bicycle and pedestrian data program. This will serve a variety of purposes, including enhancing MTC's modeling capabilities, helping prioritize needed improvements, supporting local jurisdictions' ability to secure grant funding for future projects and demonstrating the value of trails and other active-transportation improvements to the public. Specifically, MTC should expand the collection of bicycle/pedestrian/trail-count data in the Bay Area by:

  1. Collecting regional bicycle and pedestrian counts using automated count equipment and manual counts at priority locations. Trails should be included on the list of data collection locations to reflect their role in the regional transportation network.

  2. Purchasing automated count equipment and making some counters available for loan to local agencies; providing training to staff to ensure high-quality data collection.

  3. Training local agency staff to oversee volunteer-based manual count efforts.

  4. Developing and maintaining a web-based count data sharing platform, with the capability for agencies to upload and share their bicycle/pedestrian/trail-count data for use by professionals and the public.

- **Develop best practices for data collection with automated counters:** The NBPD manual count methodology has become a de facto national standard and has been adopted by MTC and the City of San Jose in the Bay Area. However, there is currently no adopted standard for collecting data with automated counters. Counters must be installed and positioned correctly and consistently or the accuracy of the data will be compromised; even data collected with the same type of counter can have very different error rates depending on the installation. Careful documentation of the data collection is also critical, even something as simple as precisely recording the time and location of the counts. The National Cooperative Highway Research Program (NCHRP) report, *Guidebook on Pedestrian and Bicycle Volume Data Collection*[6] *(Report 797)*, includes a chapter on implementing an automated counter program based on best practices around the country. MTC should adopt a data collection protocol standard, which should help address other issues such as consistency in the data collection period and techniques to extrapolate short-duration counts to annual usage.

- **Monitor and evaluate emerging bicycle and pedestrian count technologies:** Counters are produced by several manufacturers and have different features and capabilities. To date, the Eco-Counter devices appear to be the most widely used in the Bay Area, but even these counters have their limitations, and their cost is a barrier for some small agencies. As counter technology continues to evolve, there should be an effort to monitor the research on new count technologies to help determine the best tools for agencies in the Bay Area.

- **Support the enhanced applications of bicycle/pedestrian/trail count data:** Regional, county and local agencies should be encouraged to utilize trail-count data in travel models to enhance the understanding of the importance of trails in the regional transportation system. Current models typically have the capability to estimate the bicycle and pedestrian mode share, but not along specific facilities. As new modeling tools such as T-MAP become available, trails can be more fully integrated into transportation planning.

- **Encourage the inclusion of bicycle and pedestrian count equipment as part of construction project funding:** To ensure that counts are routinely collected for trail projects, funding agencies should establish requirements or incentives for applicants to include counting equipment as part of their project budgets.

- **Develop a pilot program to explore the use of crowdsourced data in analyzing bicycle and pedestrian trips:** The use of data collected by trail users through mobile applications could enhance our understanding of non-motorized travel and could inform MTC's planning travel-demand modeling activities. This is still an emerging area, and a pilot program could be valuable to assess how the data could help develop a picture of bicycle and pedestrian travel in the Bay Area.

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[6] Guidebook on Pedestrian and Bicycle Volume Data Collection, National Cooperative Highway Research Program Report 797, Transportation Research Board, Washington, DC, 2014.

Bicycle and Pedestrian Count Resources

Automatic Count Technologies, National Bicycle and Pedestrian Documentation Project, Alta Planning and Design: http://bikepeddocumentation.org/downloads

Federal Highway Administration Recreational Trails Program: https://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/99232835/page03.cfm

Guidebook on Pedestrian and Bicycle Volume Data Collection, National Cooperative Highway Research Program Report 797, Transportation Research Board, Washington, DC, 2014: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_797.pdf

Measuring Walking and Cycling Using the PABS (Pedestrian and Bicycling Survey) Approach: A Low-Cost Survey Method for Local Communities, Mineta Transportation Institute, MTI Report 10-03, 2010: http://transweb.sjsu.edu/MTIportal/research/publications/documents/2907_report.pdf

Pedestrian and Bicycle Data Collection: Quantifying Use, Surveying Users, and Documenting Facility Extent, Federal Highway administration and Pedestrian and Bicycle Information Center, 2005: http://www.pedbikeinfo.org/pdf/casestudies/PBIC_Data_Collection_Case_Studies.pdf

Pedestrian and Bicycle Data Collection, Federal Highway Administration, 2011: http://www.fhwa.dot.gov/policyinformation/travel_monitoring/pubs/pedbikedata.pdf

Pedestrian and Bicyclist Counts and Demand Estimation Study, Texas A&M Transportation Institute, 2013: http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/TTI-2013-3.pdf

Traffic Monitoring Guide, Federal Highway Administration, Washington, D.C., 2013: http://www.fhwa.dot.gov/policyinformation/tmguide/

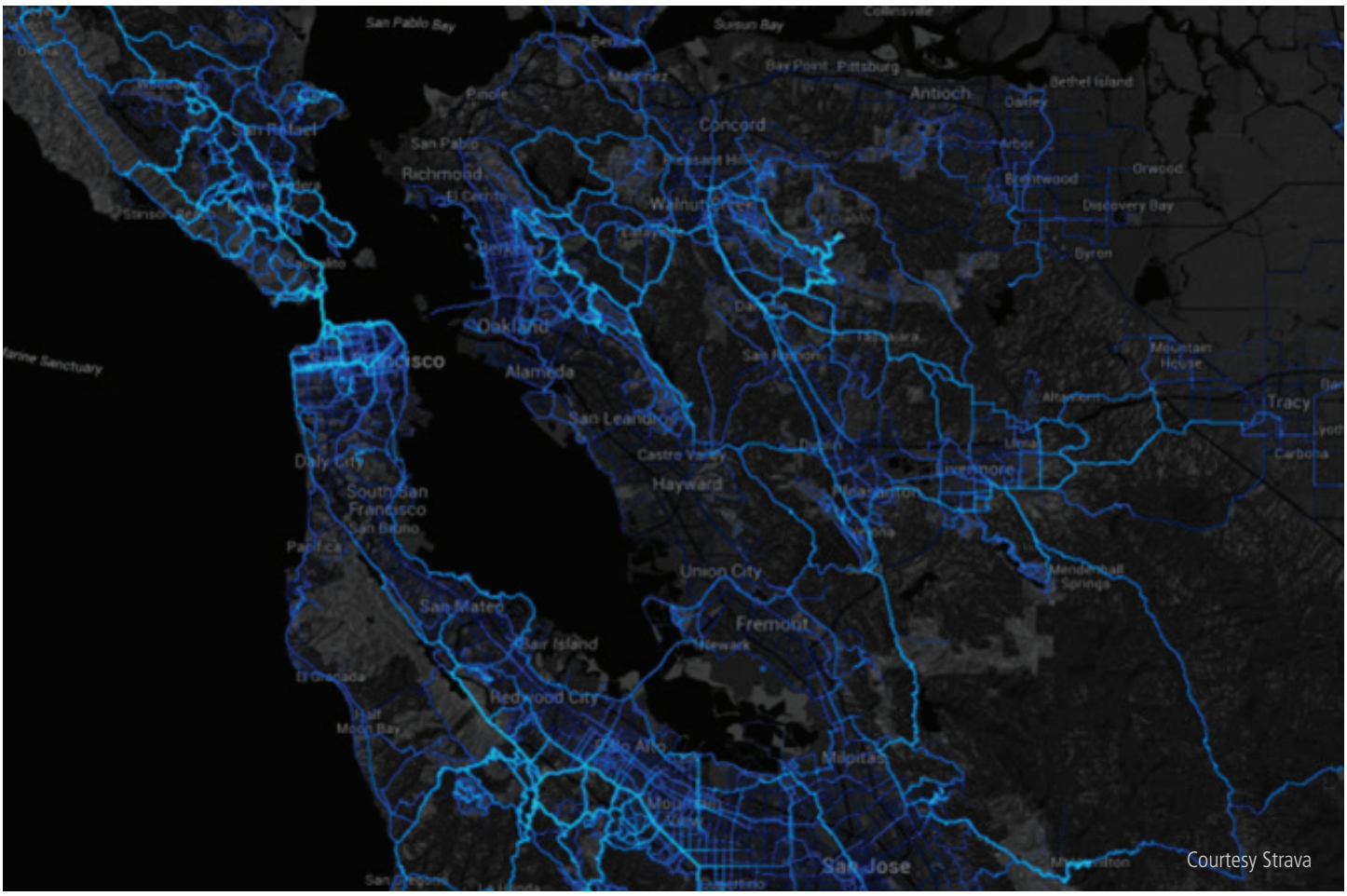
Trail User Survey Workbook: How to Conduct a Survey and Win Support for Your Trail, Rails-to-Trails Conservancy, 2005: https://www.railstotrails.org/tusworkbook

APPENDIX A. Commercially Available Bicyclist and Pedestrian Counting Technologies

Technology	Typical Applications	Strengths	Weaknesses
Inductance Loop	• Permanent counts • Bicyclists only	• Accurate when properly installed and configured • Uses traditional motor vehicle counting technology	• Capable of counting bicyclists only. • Requires saw cuts in existing pavement or preformed loops in new pavement construction. • May have higher error with groups.
Magnetometer	• Permanent counts • Bicyclists only	• May be possible to use existing motor vehicle sensors	• Commercially available off-the-shelf products for counting bicyclists are limited. • May have higher error with groups.
Pressure Sensor/ Pressure Mats	• Permanent counts • Typically unpaved trails or paths	• Some equipment may be able to distinguish bicyclists and pedestrians.	• Expensive/disruptive for installation under asphalt or concrete pavement
Seismic Sensor	• Short-term counts on unpaved trails	• Equipment is hidden from view.	• Commercially available off-the-shelf products for counting are limited.
Radar Sensor	• Short-term or permanent counts • Bicyclists and pedestrians combined	• Capable of counting bicyclists indedicated bike l anes or bikeways	• Commercially available off-the-shelf products for counting are limited.
Video Imaging – Automated	• Short-term or permanent counts • Bicyclists and pedestrians separately	• Potential accuracy in dense, high-traffic areas	• Typically more expensive for exclusive installations. • Algorithm development still maturing.
Infrared – Active	• Short-term or permanent counts • Bicyclists and pedestrians combined	• Relatively portable • Low profile, unobtrusive appearance	• Cannot distinguish between bicyclists and pedestrians unless combined with another bicycle detection technology. • Very difficult to use for bike lanes and shared lanes. May have higher error with groups.
Infrared – Passive	• Short-term or permanent counts • Bicyclists and pedestrians combined	• Very portable with easy setup • Low profile, unobtrusive appearance	• Cannot distinguish between bicyclists and pedestrians unless combined with another bicycle detector. • Difficult to use for bike lanes and shared lanes; requires careful site selection and configuration. • May have higher error when ambient air temperature approaches body temperature range. • May have higher error with groups. • Direct sunlight on sensor may create false counts.
Pneumatic Tube	• Short-term counts • Bicyclists only	• Relatively portable, low cost • May be possible to use existing motor vehicle counting technology and equipment.	• Capable of counting bicyclists only. • Tubes may pose hazard to trail users. • Greater risk of vandalism
Video Imaging – Manual Reduction	• Short-term counts • Bicyclists and pedestrians separately	• Can be lower cost when existing video cameras are already installed.	• Limited to short-term use • Manual video reduction is labor-intensive.
Manual Observer	• Short-term counts • Bicyclists and pedestrians separately	• Very portable • Can be used for automated equipment validation	• Expensive and potentially less accurate

Courtesy *Traffic Monitoring Guide*, Federal Highway Administration, Washington, D.C., 2013: http://www.fhwa.dot.gov/policyinforma¬tion/tmguide/

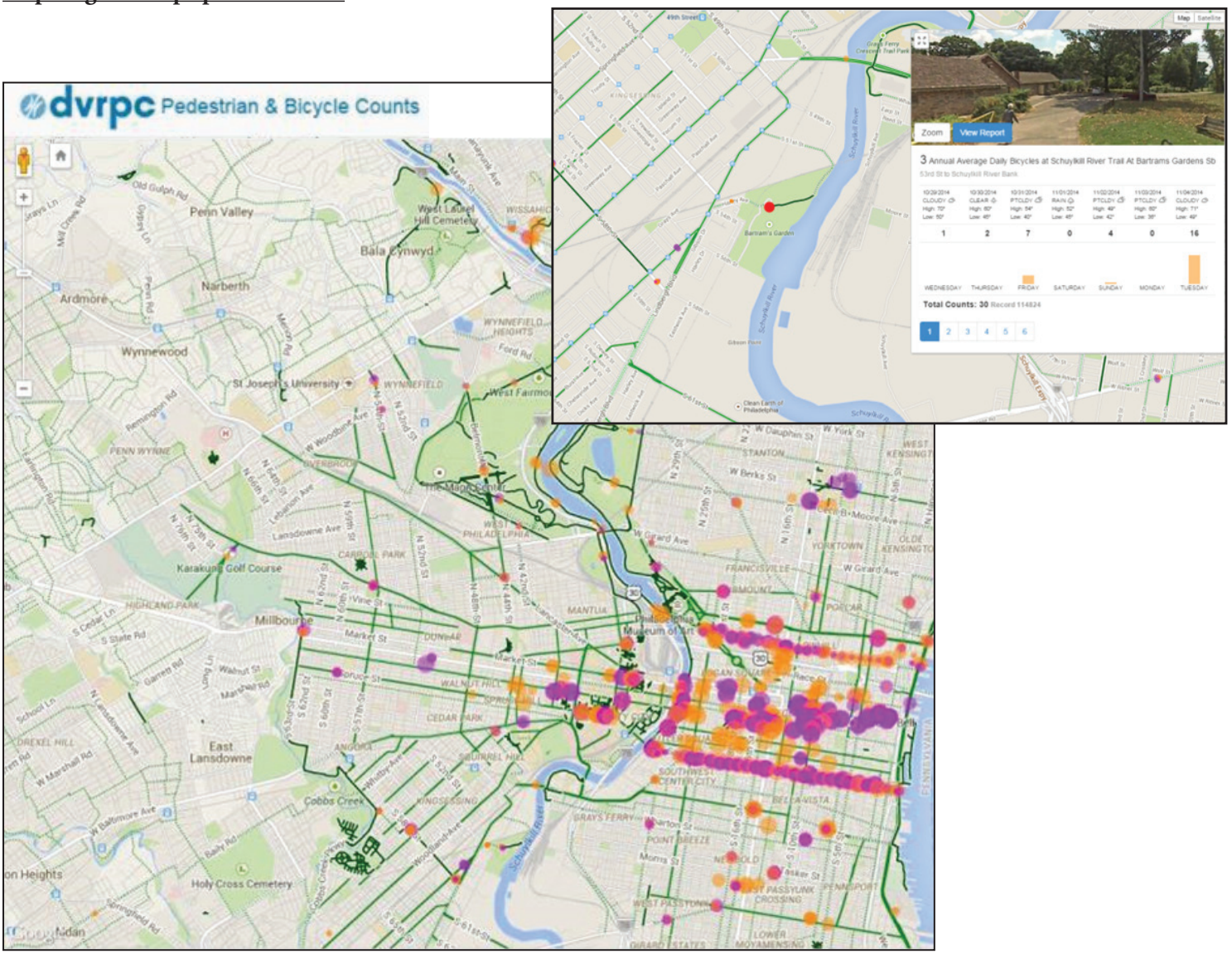
APPENDIX B. STRAVA GLOBAL HEAT MAP – SAN FRANCISCO BAY AREA TRIPS



APPENDIX C. SUMMARY OF SELECTED BICYCLE AND PEDESTRIAN COUNT DATA WEBSITES

Philadelphia Metropolitan Area Bicycle and Pedestrian Counts

dvrpc.org/webmaps/pedbikecounts



Courtesy DVRPC

DVRPC - Bicycle Count

TAKEN BY: JH **DATE:** 10/29/2014 **PROJECT:** 15-60-051 **STATION ID:**

ROAD: SCHUYLKILL RIVER TRAIL AT BARTRAMS GARDENS SB **SR/SEG/OFF:** LOCAL

FROM: 53RD ST **TO:** SCHUYLKILL RIVER BANK

STATE: PA **COUNTY:** **MCD:** 4210160110 - UNIVERSITY - SOUTHWEST

SIDEWALK: **FC:** 19 **TYPE:** BICYCLE 2

DVRPC FILE #: 114824 **COUNTER #:** 4179 **WEATHER:** f **DATA SOURCE:** EXTERNAL

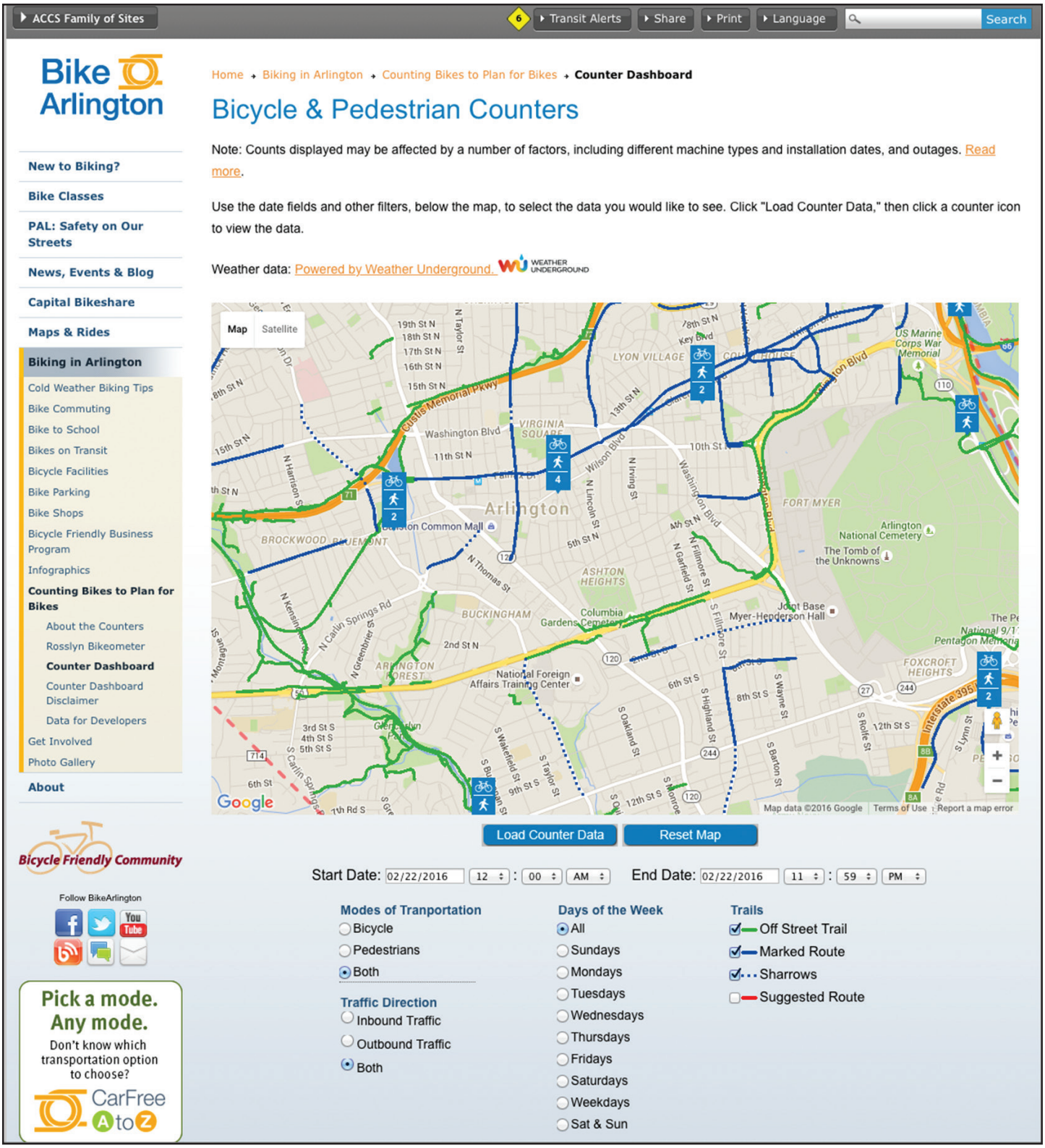
COMMENTS:

Hour Ending	Wednesday 10/29/2014	Thursday 10/30/2014	Friday 10/31/2014	Saturday 11/1/2014	Sunday 11/2/2014	Monday 11/3/2014	Tuesday 11/4/2014
High Temp	70	60	54	52	49	60	71
Low Temp	50	45	40	45	42	36	49
Weather	CLOUDY	CLEAR	PTCLDY	RAIN	PTCLDY	PTCLDY	CLOUDY
12 AM	0	0	0	0	0	0	0
1 AM	0	0	0	0	0	0	0
2 AM	0	0	0	0	0	0	0
3 AM	0	0	0	0	0	0	0
4 AM	0	0	0	0	0	0	0
5 AM	0	0	0	0	0	0	0
6 AM	0	0	0	0	0	0	0
7 AM	0	0	0	0	0	0	0
8 AM	0	0	0	0	0	0	1
9 AM	0	0	0	0	0	0	0
10 AM	0	0	0	0	0	0	10
11 AM	0	0	0	0	2	0	5
12 PM	1	0	6	0	1	0	
1 PM	0	2	1	0	1	0	
2 PM	0	0	0	0	0	0	
3 PM	0	0	0	0	0	0	
4 PM	0	0	0	0	0	0	
5 PM	0	0	0	0	0	0	
6 PM	0	0	0	0	0	0	
7 PM	0	0	0	0	0	0	
8 PM	0	0	0	0	0	0	
9 PM	0	0	0	0	0	0	
10 PM	0	0	0	0	0	0	
11PM	0	0	0	0	0	0	
Total	**1**	**2**	**7**	**0**	**4**	**0**	**16**

BICYCLE SEASONAL FACTOR: 0.99 **FACTOR:** 1.0200 **AADB:** 3

Arlington County, Virginia - Bicycle and Pedestrian Counts

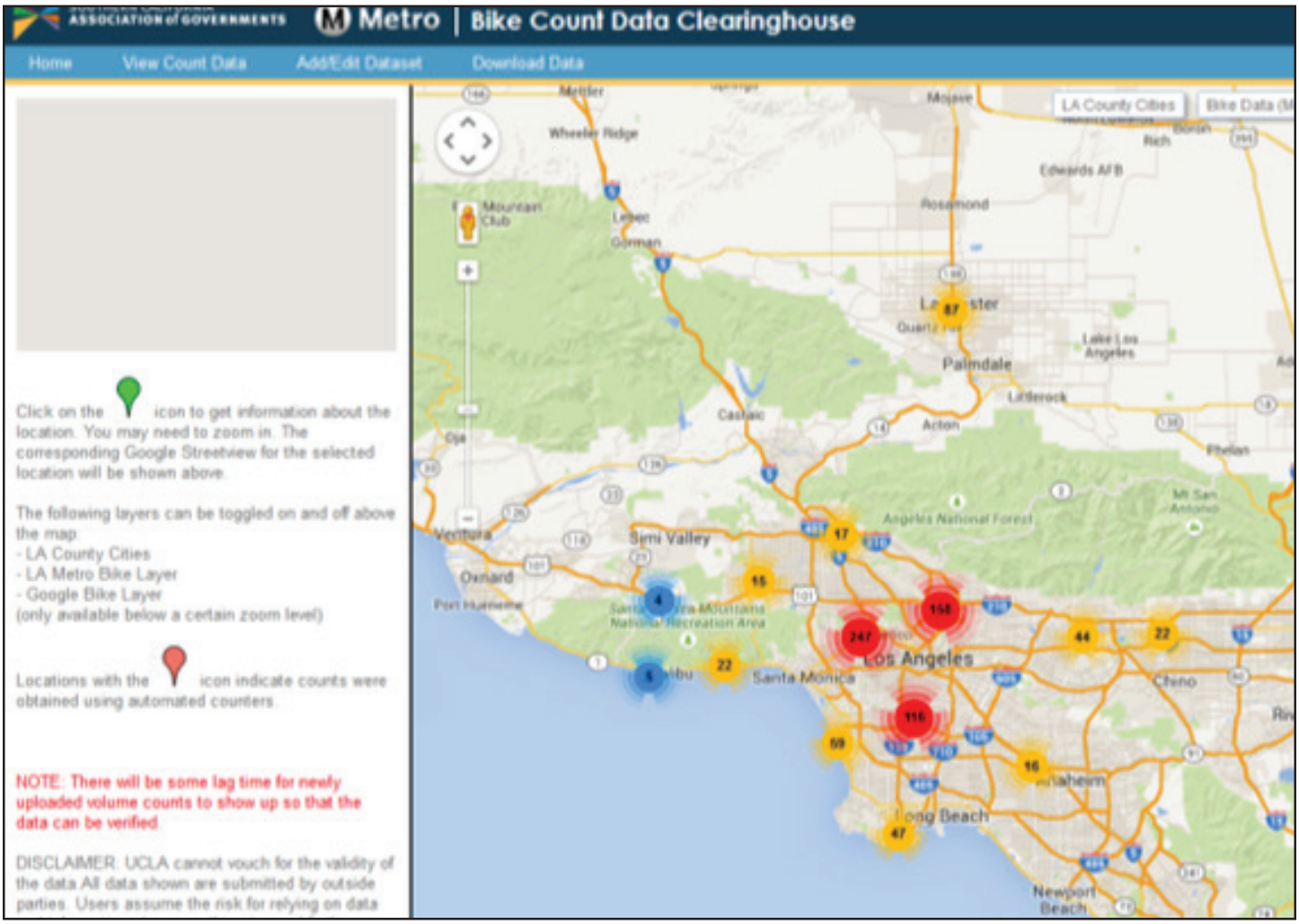
bikearlington.com/pages/biking-in-arlington/counting-bikes-to-plan-forbikes/about-the-counters



Courtesy BikeArlington.com

Los Angeles Metropolitan Area Bike Count Data Clearinghouse

bikecounts.luskin.ucla.edu



Details

Location ID: **1079**

Street: **W Ramona Blvd between San Gabriel River Trail and 605 Freeway**

Count Volumes (New) Export Count Volumes - New (CSV)

IntervalID	Date	Day	period_begin	period_end	Interval_Begin	NS	SN	EW	WE	Female	Sidewalk	Wrongway	Other_Var1	Other_Var2	Other_Var1_Count	Other_Var2_Count	Count_Method	Count_I
6093	05-31-2014	Saturday	11:00AM	1:00PM	11:00AM	0	0	1	2	0	3	0	No Helmet	Child < 12	3	0	manual_in_house	Yes
6094	05-31-2014	Saturday	11:00AM	1:00PM	11:15AM	0	0	0	8	0	6	0	No Helmet	Child < 12	4	1	manual_in_house	Yes
6095	05-31-2014	Saturday	11:00AM	1:00PM	11:30AM	0	0	3	3	0	3	0	No Helmet	Child < 12	3	1	manual_in_house	Yes
6096	05-31-2014	Saturday	11:00AM	1:00PM	11:45AM	0	0	1	1	0	2	0	No Helmet	Child < 12	1	0	manual_in_house	Yes
6097	05-31-2014	Saturday	11:00AM	1:00PM	12:00PM	0	0	1	2	1	1	0	No Helmet	Child < 12	2	0	manual_in_house	Yes
6098	05-31-2014	Saturday	11:00AM	1:00PM	12:15PM	0	0	2	3	1	5	0	No Helmet	Child < 12	5	0	manual_in_house	Yes
6099	05-31-2014	Saturday	11:00AM	1:00PM	12:30PM	0	0	2	2	0	3	0	No Helmet	Child < 12	3	0	manual_in_house	Yes
6100	05-31-2014	Saturday	11:00AM	1:00PM	12:45PM	0	0	1	3	0	2	0	No Helmet	Child < 12	4	0	manual_in_house	Yes
6109	06-03-2014	Tuesday	4:00PM	6:00PM	4:00PM	0	0	3	1	1	4	0	No Helmet	Child < 12	4	0	manual_in_house	Yes
6110	06-03-2014	Tuesday	4:00PM	6:00PM	4:15PM	0	0	1	2	0	2	1	No Helmet	Child < 12	3	0	manual_in_house	Yes

1 2 3

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