Appendix A: Technical Memorandums

Appendix A: Technical Memorandums

Technical Memorandum #5.1: Current Practices

Technical Memorandum #5.2: Best Practices

Technical Memorandum #5.3: Count Program Development

Technical Memorandum #5.1:
Current Practices

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Technical Memorandum #5.1: Current Practices

Date: May 31, 2016

Project #: 17453.005

To: Jovi Anderson, Robin Lewis, Nick Arnis; City of Bend

From: Ashleigh Griffin and Kelly Laustsen

Project: Bend Transportation Planning Strategy – Task 5: Multimodal Traffic Count Program

Subject: Technical Memorandum #5.1: Current Practices

This memorandum provides a summary of the current multimodal count programs that are operated within the City of Bend. The summary of current practices is intended to assist the City in planning and implementing a multimodal count program. By understanding the current practices within the City, including what type of data is collected regularly by various agencies, how the data is used, and how the data is stored, the City can better plan a system that builds upon existing activities and incorporates data from these activities. In addition, the City can learn from the positive and negative experiences agencies have had with various data collection technologies and methodologies.

The current practices are summarized by agency, with a summary of implications for the City of Bend's new program at the conclusion of the document.

- City of Bend Count Programs;
- Bend Park and Recreation District (BPRD) Count Program;
- Deschutes County Count Program;
- Oregon Department of Transportation (ODOT) Count Programs; and
- Conclusion.

CITY OF BEND COUNT PROGRAMS

The City of Bend had a more robust vehicular count program in place prior to 2008. Today, most regular pedestrian and bicycle counts are conducted with the help of volunteers; vehicle counts are not conducted on a regular schedule. This section summarizes the past and current count programs operated by the City of Bend.

Past Counting Programs

Prior to 2008, the City operated two on-going count programs: tube counts and plate counts. The two programs are summarized below.

Tube Counts

The tube counts program was operated prior to 2008 and used specific locations around the City to assess growth. These locations included major routes, arterials and collectors, and some locations in-between. Counts were repeated every three years when possible. The City was divided into thirds, and each year data was collected at one group of locations. The data was collected by an external company rather than City staff.

Counts were conducted between Tuesday and Thursday using tubes that collected vehicle counts and classification. No bicycle or pedestrian counts were collected.

Data was entered into an Access database manually and then added to the GeoBlade system. The data was useful to assess changes over time and provided vehicle speed information to City staff.

Plate Counters

In addition to the regular vehicle counts conducted with tubes, the City also had plate counters that were used primarily to respond to citizen service requests on local streets. These were small, 4" by 6", NuMetrics Hi-Star plates that counted volume by lane. City staff and crews installed these as requested.

The data from the plates produced a PDF report that was then manually entered into the Access database and then to GIS. The manual data input was a tedious process for staff.

Overall this program was ineffective because random locations were conducted based on citizen requests. Plates were also occasionally stolen or caused citizen concerns. In addition, staff was not always available to install the plates. The program ended prior to 2009 because it was inefficient to keep up with the technology and changes.

Other Counts

In addition to the two regular programs, the City also had techs periodically collect turning movement counts. These were stored in a Traffix program.

Current Counting Programs

Currently, the City operates a volunteer-based pedestrian and bicycle count program. There is no current vehicle count program. The City relies on data from other sources to supplement their data and conducts counts on an as-needed basis.

Pedestrian and Bicycle Count Program

The current pedestrian and bicycle count program relies on volunteers to collect the data as no staff resources are available for conducting these counts. The program began about two years ago, and counts are conducted at each of the 24 locations four times per year, pending sufficient volunteers.

The count locations were selected by a committee when the program began. The bridge locations are a top priority. Typically, approximately 75 percent of the locations are covered by volunteers, who select the location they would like to count when they sign up. However, if some of the important locations, such as bridges, are not covered by volunteers, City staff may ask volunteers to change locations to cover the most critical locations.

Volunteers record the number of pedestrians and bicyclists at their location during a two-hour period from 3:30 to 5:30 p.m. on a weekday and/or noon to 2:00 p.m. on a Saturday. No additional demographic data is collected. Although there is no in-person training, volunteers are provided with a training presentation, consent form, and information on how to collect data from National Bicycle and Pedestrian Documentation Project (NBPD) project.

Data is manually entered and saved in Google Earth. The count locations are stored in a GIS file, but none of the count data is currently tied to these locations.

Other Data Sources

The City receives additional data from other sources, as summarized below. Deschutes County, ODOT, and BPRD programs are summarized in more detail in later sections of this memorandum.

- Project based data, such as data collected for corridor studies or roadway projects, is available for some projects completed in 2009 or later. The City does not have a large amount of other data, and the data available is in a variety of formats. Quality Counts typically collects this data.
- ODOT provides automated traffic recording (ATR) counts at five locations on state facilities (four within the City). Data is provided to the City/MPO monthly in PDF form.
- ODOT also provides 48-hour counts to the City each year. ODOT conducts these counts on a rotating cycle every three years.
- Counts are conducted every five years to update the MPO travel demand model. The most recent data was collected in 2013. ADT counts are collected at a variety of locations to complete these updates. Data from these counts is available on the City's GeoBlade website.
- Quality Counts has some historical data available online which may be available for purchase by the City.
- Bend Park and Recreation District (BPRD) provides the City with data from their trail counters on an annual basis.
- Some data is obtained from traffic impact analyses (TIAs) that are submitted to the City. However, very little data is actually stored from these studies. There is no system in place for obtaining data from TIAs or requiring data in a certain format. Currently, TIAs are uploaded as PDFs, which makes input of data time consuming. Excel versions of counts would enable easier data uploading.
- The City's police department has speed signs that collect speed and volume data, as illustrated in Figure 1. The signs are portable and easy to move and are placed based on citizen requests.

Data from these signs is primarily available from local streets at random times. However, no calibration has been done to check the data. Data is provided quarterly.

- Having a way to normalize or calibrate the data would allow the data to be more useful. It may be useful for noting traffic calming needs and other issues.

TRAFFIC SURVEY - SPEEDWATCH - May/June/July 2015

BY LOCATION

Date	Area	Vol.	Start Time	Stop Time	Posted Speed	Total Vehicles	# Vehicles +5 to 10	# Vehicles +10 to 15	# Vehicles +15	Comments	Percent > +11
5/4/2015	NE 18th/Sky View SZ	TA	13:25	13:45	20	60	10	3	6	Both Directions (43)	15.00%
5/14/2015	NE 18th/Sky View SZ	TA	11:19	11:34	20	41	5	6	3	Both Directions (45)	21.95%
5/4/2015	NE 27th/MVHS SZ	TA	12:34	12:54	20	326	34	15	3	Both Directions (36)	5.52%
5/14/2015	NE 27th/MVHS SZ	TA	10:40	10:55	20	221	22	9	1	Both Directions (36)	4.52%
5/4/2015	NE Egypt/Lava Ridge ES	TA	13:48	14:08	25	19	1	0	0	Both Directions	0.00%
5/14/2015	NE Egypt/Lava View	TA	11:40	11:55	25	16	4	1	0	Both Directions	6.25%
6/10/2015	NE Jones & Thompson	CN	11:36	11:50	25	76	5	1	0	Both Directions	1.32%
5/20/2015	NE Neff/Pilot Butte SZ	CN	11:56	12:13	20	342	8	6	1	Both Directions	2.05%
5/4/2015	NE Purcell/Aspen Ridge	TA	12:08	12:28	25	177	52	18	0	Both Directions	10.17%

Figure 1. Sample Data from Speed Signs

Current and Future Data Applications

The City has several current applications for the data it collects and several additional needs that the new count program should address. In order to make the data most useful, the City needs a structure for collecting, storing, and using the data. GeoBlade currently houses much of the data available, but most of this data was collected prior to 2009. Volume data is the second highest item extracted by GeoBlade users. The more current data available on GeoBlade (after 2009) is primarily from the MPO model update, the ODOT counts, the volunteer based pedestrian and bicycle counts, and a few TIA counts.

The City's current applications for the data include:

- Responding to citizen services requests;
- Calculating crash rates for use in the safety program;
- Responding to requests for data from developers; and
- Completing grant applications, such as grants for bike and walk friendly communities, new crossings, etc.

The City's desired future data includes:

- Data for multi-lane roads and crossings where enhanced pedestrian crossings are being considered;
- Understanding the percentage of trucks on freight routes;
- Understanding volumes on all bridges;
- Summarizing growth trends by mode as different systems are enhanced. Before and after data would be helpful for grant reporting; and

- Identifying peak hours from counts throughout the day to help with developing more robust Transportation Demand Management (TDM) programs, maximizing existing system capacity by spreading trips, and moving towards peak hour shifting.

The City hopes to use the future count program and data for the following applications:

- Growth management department planning projects;
- Pavement preservation work and prioritization;
- Transportation System Plan (TSP) update;
- Targeted police enforcement; and
- Project specific support.

BEND PARK AND RECREATION DISTRICT COUNT PROGRAM

The Bend Park and Recreation District (BPRD) maintains and operates parks and trails throughout the City of Bend. BPRD runs a count program to track the number of users on some of the trails. The count program began in 2012 and relies on automated counters.

BPRD does not regularly collect or store vehicle count data. In the past (over ten years ago), the district owned tube counters which were used to count the number of vehicles using various parking lots. However, this practice is no longer in place.

Pedestrian and Bicycle Count Program and Technology

BPRD uses TRAFx infrared trail counters to collect data. The counters are battery powered and typically changed about once per year. When selecting a technology to purchase for their counts, BPRD selected TRAFx due to the good references, ease of self-installation, and lower cost of TRAFx compared to alternatives. The purchase price initially was around $1,700, which included the software that accompanied the technology. TRAFx came with a two year license for the software and updates. Additional counters were purchased for approximately $500 each. To obtain data from the counters, a user must manually download the data from the counter at the site; the counters do not automatically upload data to the cloud or other storage system. BPRD typically downloads the data about every two months.

Count Locations

When BPRD began the count program, they moved the counters around to various trails, leaving them on each trail for one to two weeks during the summer, resulting in counts for approximately 15 sites each year.

Currently, BPRD owns seven counters. Six are placed in permanent locations where they will stay for at least one year. Some of these are mounted in bollards or other hidden locations. One portable counter is kept in a weather tight powerbox and moved around as needed.

Locations are selected based on usage data from old counts. Locations with the highest volumes are prioritized for counting. Only BPRD trails are counted; trails that fall within other jurisdictions are not counted. *Attachment A shows the locations of BPRD trail counts.*

Challenges and Considerations

The district has encountered some challenges and considerations that are relevant to the City of Bend's program development. These are summarized below:

- The TRAFx counters that BPRD uses work in all types of weather.
- Vandalism and cut locks have been an issue. Even when the counters are hidden in bollards, they have experienced some vandalism. Theft has not occurred.
- The placement of the counters is important, particularly the height. If the counters are too low, they may pick up dogs, but if they are too high, they may miss children. The counters also must be placed at locations on trails where they are most likely to get an accurate count of the data the user is hoping to capture. For example, counts at the pedestrian path at Colorado Avenue were used to estimate the number of people floating the river.
- The counters do not distinguish between pedestrians, bicyclists, dogs, and wildlife such as deer. Therefore, they cannot be used to provide a mode split.
- No demographic data is recorded.
- The counters require manual calibration as well as manual downloading at the site. Checks of the counters have found that the TRAFx counts are close but slightly lower than the true numbers.

Data Format and Usage

Data from the TRAFx counters is processed using the software that accompanies the counters and stored in a spreadsheet format. The software comes with a mapping program that can generate reports from the data. The data is shared with the MPO in a spreadsheet format as illustrated in Figure 2. Data is also shared with others who express interest or request the data. *The full spreadsheet summarizing the data is provided in Attachment A.*

Data is used for a variety of purposes, as summarized below:

- Police use it to track activity during nighttime hours;
- Maintenance staff rely on the data to understand usage trends and where increased maintenance efforts are needed;
- Event planners use the data to identify preferred trails for events such as races;

- Budgeting relies on the data for prioritizing improvements; and
- Other programs such as the stewardship program and signage programs rely on the data for occasional use.

BPRD Automated Trail Counter Program														
Year	Map	Location	Start Date	End Date	Total	Days	Daily AVG	24-Hr Peak	Peak Day	Peak Hr	Peak Time	Facility	Surface	Comments
BPRD Automated Trail Counter Program														
Year	Map	Location	Start Date	End Date	Total	Days	Daily AVG	24-Hr Peak	Peak Day	Peak Hr	Peak Time	Facility	Surface	Comments
	1	DRT East @ Pioneer Park in wooded area	5/13/2014	5/18/2014	2,201	6	367	452	Tuesday			Trail	natural	*mobile counter*
			5/16/2012	5/21/2012	733	6	122	158	Saturday	17	2pm	Trail	paver	*Sunny 63-86*
	2	DRT (east side downstream of S. Canyon Bridge gate)	5/16/2012	5/21/2012	2,296	6	383	449	Sunday	38	12pm	Trail	gravel	*Sunny 63-86*
	3	First St. Rapids DRT West		Apr 2015	12,521		417		Sunday		4pm	Trail	gravel	*fixed counter*
				Mar 2015	12,660		408		Sunday		4pm	Trail	gravel	*fixed counter*
				Feb 2015	9,473		338		Sunday		4pm	Trail	gravel	*fixed counter*
				Jan 2015	N/A				Sunday		4pm	Trail	gravel	*fixed counter*

Figure 2: Example of BPRD Trail Count Data

DESCHUTES COUNTY COUNT PROGRAM

Deschutes County collects vehicle traffic volumes on County roads each year. No pedestrian or bicycle counts are regularly conducted by the County. The County count program began in the late 1990s. The County owns eleven tube counters and uses these to conduct the counts themselves. Intersection counts are not part of the regular program; intersection counts are only conducted as requested or if a significant project is planned for the area.

The recurrence frequency of counts for each road varies based on the traffic volume of the road, as summarized below:

- Roads with more than 5,000 ADT are counted every year;
- Roads with 3,000 – 5,000 ADT are counted every other year;
- Roads with 1,000 to 3,000 ADT are counted every third year; and
- Roads with less than 1,000 ADT are counted every fourth year.

If scheduled counts are unable to be completed during the scheduled year, they are combined with the following year's scheduled counts.

Raw data from the counters is stored on the County's Network Server. The analyzed data, which provides the ADT number, is kept in a database program created by the County. This spreadsheet type format is linked to an internal GIS program as well. The tube counters collect speed data, but the speed data is not currently stored. No additional data is stored from other projects or traffic impact studies.

The count data is shared with the public on the County Road Department's website, as illustrated in Figure 3. The current data information is available in spreadsheet as well as PDF format and generally includes nine years of data. The data is used for the pavement management program, neighborhood requests, crash rate calculations, and other project and planning level needs that arise.

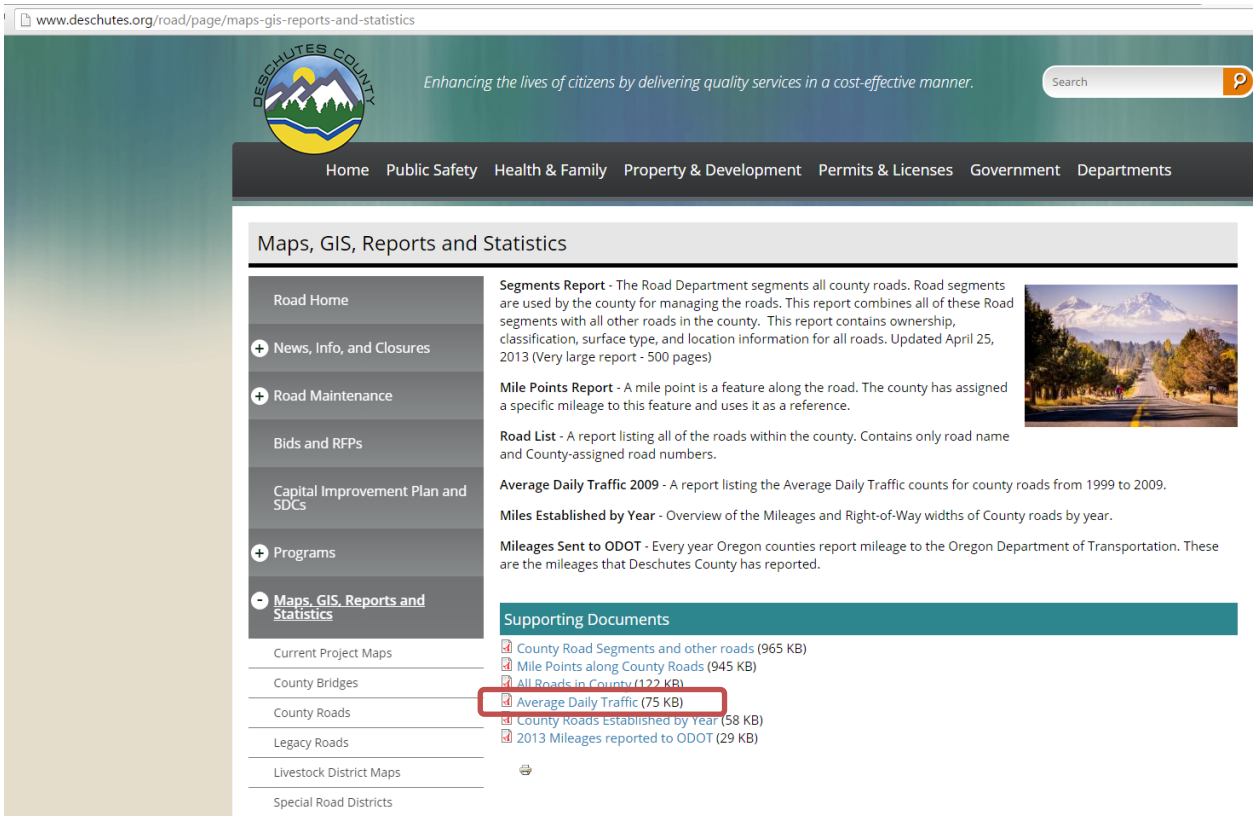


Figure 3. Deschutes County Road Department Website

OREGON DEPARTMENT OF TRANSPORTATION COUNT PROGRAMS

The Oregon Department of Transportation (ODOT) operates two regular count programs: the coverage count program and the highway performance monitoring system (HPMS). Both of these programs collect vehicle counts. Although ODOT owns four bike counters, there is currently not a robust counting program in place for pedestrians and bicyclists.

Coverage Count Program

The coverage count program is the program that ODOT uses to collect counts on the state highway system. The goal of this program is to conduct enough counts that they have adequate volumes to represent all ranges of the highway system. ODOT splits the highways into sections with various ranges of AADT (for example, 2,500 – 5,000 ADT) and collects data on these sections on a three year cycle. Counts are done on sections with consistent traffic within the segment (where traffic volumes are not changing). Counts are typically done in the spring and fall, when minimal seasonal adjustments are needed. ODOT attempts to count the same locations over time when possible for use in developing historic trends. These coverage counts are conducted with pneumatic tubes and are typically 48-hour counts. When locations do not permit tubes to be used safely, videos are used to conduct the counts.

In addition to the rotating counts conducted on three-year cycles, ODOT also maintains continuous counting stations. Counts at these locations are conducted with inductive loops. There are approximately five locations in Bend. These continuous counting locations are used to provide seasonal factors for sites. Some of these sites can determine weight and the number of axles on a vehicle. However, the equipment does not hold up as well in some highway compositions.

The ultimate goal of the coverage counting program is to have data that represents data for the year and for use in comparing sites. Depending on when counts are taken, factors are applied to adjust the count based on the day of the week, month of the year, axle overcount factors, and growth factors since counts are conducted only once every three years. If two adjacent sections start to show similar traffic volumes multiple years in a row, ODOT may consider dropping one site and extending the range of that section. ODOT recognizes that history is important for many analyses and provides comparable data whenever possible.

Highway Performance Monitoring System (HPMS)

The second major count program is the Highway Performance Monitoring System (HPMS), which includes counts on roads of all jurisdictions. These are used to show stewardship for federal funds. Counts must be done every three years. The majority of these counts are conducted during the summer months.

These counts are also used by the MPO to calculate vehicle miles traveled (VMT) for the whole system. Therefore, they must have enough counts to estimate VMT on roads of all functional classifications; many non-state, local roads are counted through this program.

On higher volume routes, segments for counts are broken where the volumes change by more than 10 percent. On lower volumes routes, they are often broken where volumes change by smaller percentages.

Other ODOT Counting Efforts

Although the Coverage Count Program and the HPMS make up the largest count programs that ODOT runs, data is collected through smaller efforts as well.

- The rail group asked the counting group to coordinate data collection for each rail crossing for use in safety analysis. ODOT uses what they can from the local jurisdictions and supplements it with additional counts. Rail crossing counts are conducted on a six-year cycle.
- Special counts are conducted by ODOT staff for specific projects or planning efforts. Video is used for turning movement and pedestrian/bicycle counts.

Data Processing and Storage

ODOT's count data is initially processed by the vendor software for each technology. The local, region-based counting group does an initial review of the data to make sure the data appears to be correct before Salem staff load the data into ODOT's primary count database. For example, zero data for several hours in a row may indicate a parked car, or one to two days of drastically different volumes from other days may indicate the need to collect new data.

ODOT's current count database is the Traffic Count Management System (TCM) which was developed by PTV in 2008. This software provides graphical presentation of the counts. It also provides the past history of counts, which ODOT uses to make sure the data makes sense. The program applies the seasonal, axle, and growth factors to the counts. ODOT staff finish processing the data in Excel to produce AADTs for publication and comparing sites.

PTV has stopped supporting the TCM software. ODOT is currently in the process of completing demos with other commercial software packages to find a replacement for the TCM. The process of selecting a new service may take several years, depending on how long it takes to secure funding. The current options being considered are:

- MS2 (produced by Midwestern Software Solutions, LLC): This company has more experience with local jurisdictions and state DOTs compared to some of the others.
- Jackalope (produced by High Desert Traffic): This company has good experience with state DOTs.
- Transmetric: This company is breaking into the US market. They have more foreign experience and started in Australia.
- Drakewell: This company is based in the United Kingdom and has more experience with European and Middle East markets.
- In-house development: ODOT is also considering building its own system in-house. WashDOT has successfully built an in-house system; ODOT will review WashDOT's experiences in making a decision.

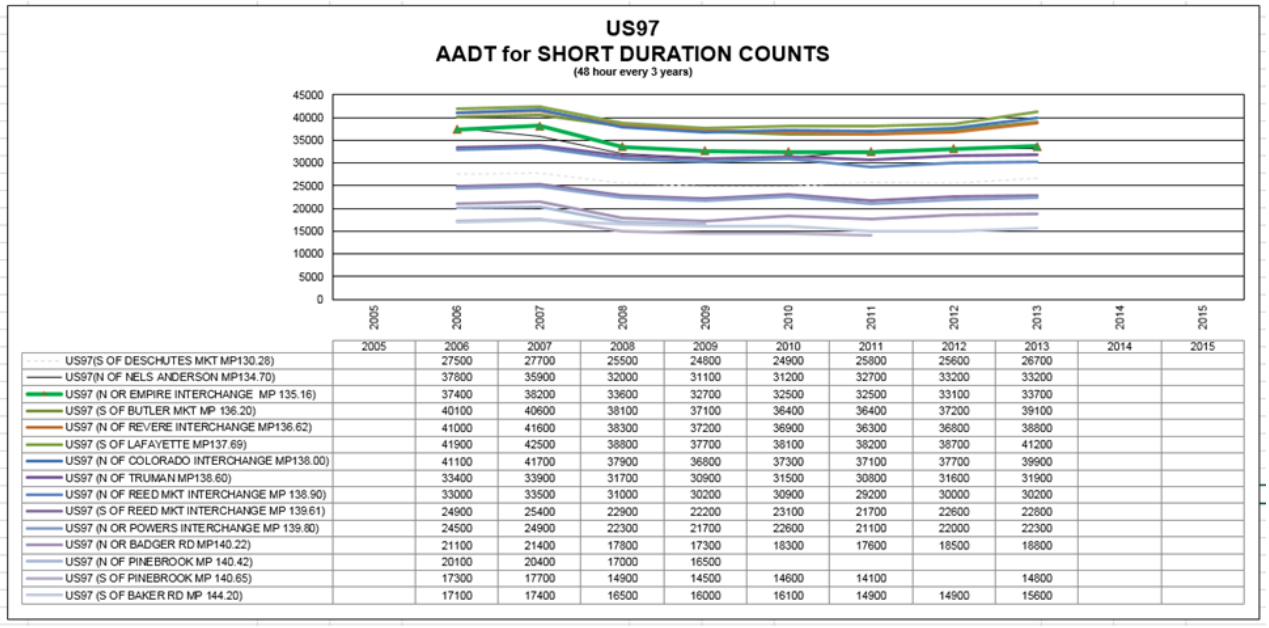
Data Applications

ODOT count data is regularly used by the planning groups and for specific projects within ODOT. The planning department relies on the data for forecasts and projections. The projects often rely on special counts, including turning movement counts, rather than the regular cyclical counts from the two main programs. In addition, traffic counts are used for economic purposes to evaluate general trends in volumes.

Data Sharing

Count data can be obtained from anyone and is often requested for a variety of reasons. Local jurisdictions like to see their data to identify trends for the area. Realtors and citizens often request

counts; realtors use data to advertise commercial sites. Figure 4 illustrates data provided by ODOT to the MPO.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
US97(S OF DESCHUTES MKT MP130.28)		27500	27700	25500	24800	24900	25800	25600	26700		
US97(N OF NELS ANDERSON MP134.70)		37800	35900	32000	31100	31200	32700	33200	33200		
US97 (N OR EMPIRE INTERCHANGE MP 135.16)		37400	38200	33600	32700	32500	32500	33100	33700		
US97 (S OF BUTLER MKT MP 136.20)		40100	40600	38100	37100	36400	36400	37200	39100		
US97 (N OF REVERE INTERCHANGE MP136.62)		41000	41600	38300	37200	36900	36300	36800	38800		
US97 (S OF LAFAYETTE MP137.69)		41900	42500	38800	37700	38100	38200	38700	41200		
US97 (N OF COLORADO INTERCHANGE MP138.00)		41100	41700	37900	36800	37300	37100	37700	39900		
US97 (N OF TRUMAN MP138.60)		33400	33900	31700	30900	31500	30800	31600	31900		
US97 (N OF REED MKT INTERCHANGE MP 138.90)		33000	33500	31000	30200	30900	29200	30000	30200		
US97 (S OF REED MKT INTERCHANGE MP 139.61)		24900	25400	22900	22200	23100	21700	22600	22800		
US97 (N OR POWERS INTERCHANGE MP 139.80)		24500	24900	22300	21700	22600	21100	22000	22300		
US97 (N OR BADGER RD MP140.22)		21100	21400	17800	17300	18300	17600	18500	18800		
US97 (N OF PINEBROOK MP 140.42)		20100	20400	17000	16500						
US97 (S OF PINEBROOK MP 140.65)		17300	17700	14900	14500	14600	14100		14800		
US97 (S OF BAKER RD MP 144.20)		17100	17400	16500	16000	16100	14900	14900	15600		

Figure 4. Example of AADT Data ODOT Provides to MPO

Summary statistics for the counts can be obtained from ODOT's TransGIS website, illustrated in Figure 5. TransGIS traffic data provides the user with AADT information and vehicle classification information. More in-depth data and raw data is often requested; ODOT shares time series or intersection reports as requested.

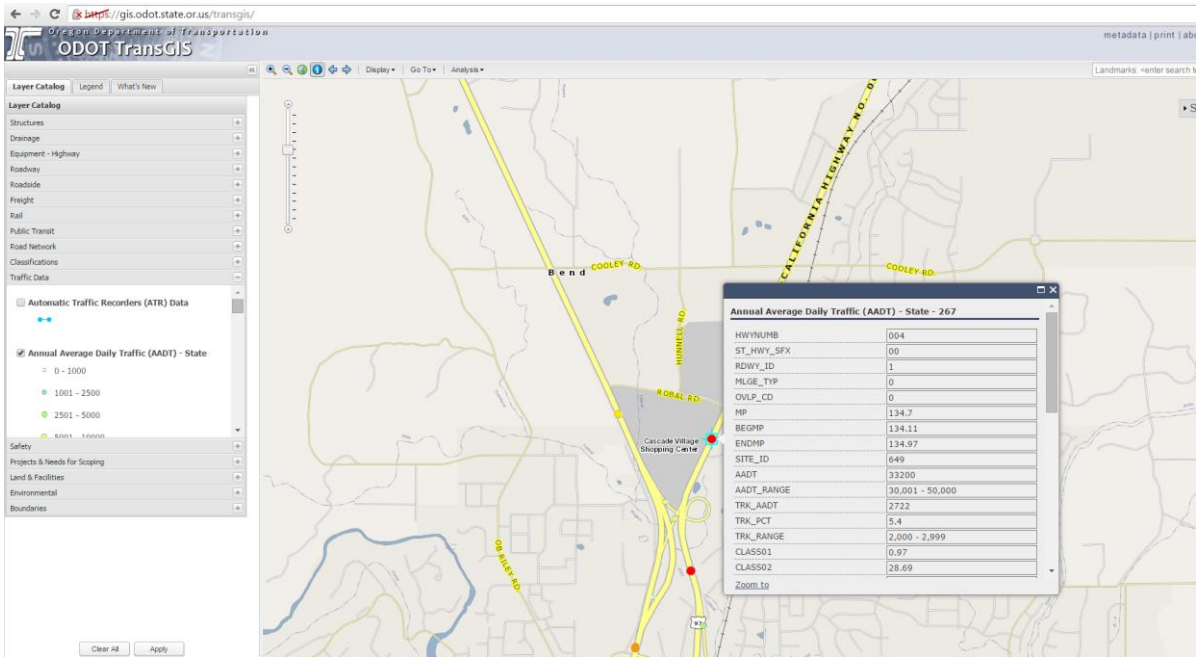


Figure 5. ODOT's TransGIS Website

ODOT does not store much data from traffic impact analyses (TIAs) in the TCM. ODOT does attempt to save data from projects when counts of at least 16 hours in duration are collected because the 16-hour or longer counts have a wide variety of uses for a variety of people. In contrast, peak hour counts have limited use. ODOT staff prefer when data is provided in Excel format; PDF format requires manual entry into the system.

Pedestrian and Bicycle Counts

Pedestrian and bicycle counts are not regularly conducted by ODOT. Although the majority of counts are done manually or with video, which is then reduced by staff watching the videos, ODOT owns four bicycle counters and uses them on ODOT facilities. ODOT relies on other agencies that collect pedestrian and bicycle data to review seasonal variations.

The four bicycle counters that ODOT uses are produced by two different companies:

- On the I-205 bicycle path, loops that were installed in the 1980s are still used today. ODOT previously had a bike counting program that included between seven and nine counters around the state. These counters were diamond loops in the path combined with a regular counter on the side of the path. The counter on the I-205 path is the last counter remaining from this program.
- On the US 101 coastal route, ODOT uses one counter near Bandon and one counter near the US 26 interchange. These counters are Eco-Counter loops in the shoulders.
- Another Eco-Counter bike counter is located in the Gorge.

ODOT has found that all of the counters undercount slightly. As bicycle technology changes, there is less metal on the frames, which leads to some undercounting. ODOT conducts field verification of the bicycle sites occasionally. The I-205 counter reported about 20 percent undercounting.

Data is downloaded from the Eco-Counter sites manually. Staff must travel to the site to collect the data and upload it. The I-205 counter has a standard modem and can be collected from staff in the office.

ODOT is testing Eco-Counter's modem service on the north coast. The modem service automatically collects the data each day. However, one of the Eco-Counters was placed in a location where the cellular service is not strong enough for the automatic data upload to function properly. The cell phone used to check service availability was 4G, but the Eco Counter is 3G.

Within Bend, ODOT has also assisted the City with pedestrian and bicycle counts using video to supplement the volunteer count program.

Counts from Signals

Traffic signals around the City of Bend may be able to provide some count information, although the accuracy and reliability of the data should be a consideration in its use. The Oregon Department of Transportation collects vehicle volume data from traffic signals. The 2070 signal controllers are able to collect volume. The older 1070 controllers are also capable of collecting volume, but the software no longer functions. ODOT has plans to upgrade the few remaining 1070 controllers in Bend to 2070 controllers by 2016.

Although the 2070 controllers are able to collect volume data, the data has not proven to be accurate. ODOT is working on a study with Northern Arizona University and Portland State University to compare video detection, loops, and other types of detection for both vehicles and bicycles. Most of the signals use video detection because the in-pavement loops do not hold up well with the high volume of studded tires used in Bend. Although the research is still in progress, it has shown that video detection tends to undercount when the signal is not saturated. However, when the signal is saturated, the video detection tends to lump vehicles together. ODOT has also attempted to use bike detection zones with videos, but these have been triggered by vehicles and therefore are not yet reliable.

ODOT is currently testing an Iteris camera at the intersection of US 20/Robal Road. Preliminary results have indicated that the differentiation between vehicles and bicyclists needs improvement. The video does not detect a bicycle if it does anything that travel straight forward using the bicycle lane. For example, if the bicycle moves into a travel lane, it is not counted. In addition, the camera tends to count a group of bicycles as one bicycle.

ODOT has a permanent installation of pedestrian detection cameras in Biggs Junction. However, these have not proven to be accurate. The video sometimes puts in false calls and will also drop the call if the pedestrian moves in the wrong direction.

ODOT collects push button actuation information from signals, but they have no information about the total number of pedestrians using the crossing based on this information. Data is available in terms of the number of actuations per hour. ODOT has not done any studies to determine what the average group size is at signalized crossing or any other calibration efforts to make the number of actuations per hour reliable as a source of count data.

Although the video detection technology is not ready for full implementation yet, it is a popular topic with current research in the field focusing on how to improve the detection and differentiation performance. ODOT ultimately hopes that they will be able to optimize signal timing based on the presence of bicyclists at the intersection. Once the detection and differentiation performance of video systems is improved, these systems may provide valuable count information for the City of Bend.

GOALS FOR THE CITY OF BEND COUNT PROGRAM

Based on the review of current practices within the City, County, BPRD, and ODOT, the City of Bend has developed the following goals for the development of the new count program.

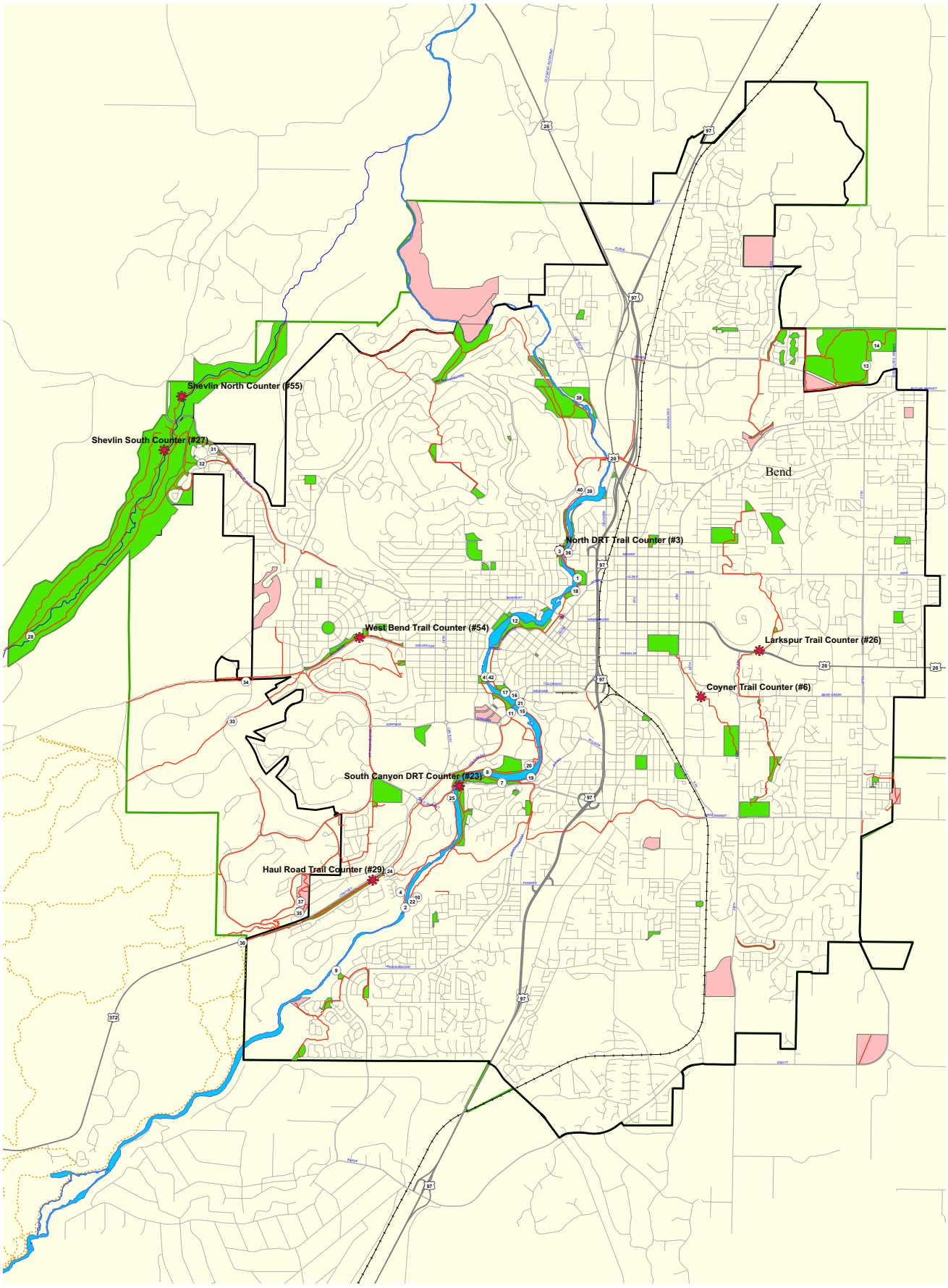
- The count program should be easy to implement with minimal staff time required for maintenance or data manipulation. Data should be accessible without a field visit.
- The data should provide mode split information.
- Locations for data collection should be selected to allow for corridor trend analysis as well as regional analysis.
- Locations for data collection should supplement locations where ODOT, Deschutes County, and BPRD already collect regular data.
- Locations for data collection should be developed systematically rather than randomly in response to requests.
- The storage system for the counts should allow for incorporating data from other agencies as well as other projects such as TIAS.
- The storage program should provide some flexibility to allow for future changes to incorporate new data, such as demographics.

REFERENCES

- Jovi Anderson, Bend MPO
- Robin Lewis, City of Bend
- Chris Doty, Deschutes County
- Steve Jorgensen, Bend Park and Recreation District
- Sasha Sulia, Bend Park and Recreation District
- Don Crownover, Oregon Department of Transportation
- Paul Tiller, Oregon Department of Transportation
- Dave Hirsch, Oregon Department of Transportation

ATTACHMENTS

Attachment A: BPRD Trail Count Locations and Data



Legend

- BPRD Fixed Trail Counter Location
- Historic Shevlin Railway Route

Public Trails

- Existing Trail
- USFS Trails
- Developed Park
- Undeveloped Park
- Urban Growth Boundary
- Park District Boundary

Trail Count Locations

N W E S

Not to Scale

play for life

Map Date: 10-8-15

Bend Park & Recreation DISTRICT

BPRD Automated Trail Counter Program														
Year	Map	Location	Start Date	End Date	Total	Days	Daily AVG	24-Hr Peak	Peak Day	Peak Hr	Peak Time	Facility	Surface	Comments
	1	DRT East @ Pioneer Park in wooded area	5/13/2014	5/18/2014	2,201	6	367	452	Tuesday			Trail	natural	*mobile counter*
			5/16/2012	5/21/2012	733	6	122	158	Saturday	17	2pm	Trail	paver	*Sunny 63-86*
	2	DRT (east side downstream of S. Canyon Bridge gate)	5/16/2012	5/21/2012	2,296	6	383	449	Sunday	38	12pm	Trail	gravel	*Sunny 63-86*
	3	First St. Rapids DRT West		Apr 2015	12,521		417		Sunday		4pm	Trail	gravel	*fixed counter*
				Mar 2015	12,660		408		Sunday		4pm	Trail	gravel	*fixed counter*
				Feb 2015	9,473		338		Sunday		4pm	Trail	gravel	*fixed counter*
				Jan 2015	N/A				Sunday		4pm	Trail	gravel	*fixed counter*
				Dec 2014	8,069		261		Sunday		4pm	Trail	gravel	*fixed counter*
				Nov 2014	8,119		270		Sunday		4pm	Trail	gravel	*fixed counter*
				Oct 2014	9,992		322		Sunday		4pm	Trail	gravel	*fixed counter*
				Sept 2014	11,334		378		Sunday		4pm	Trail	gravel	*fixed counter*
				Aug 2014	13,797		445		Sunday		4pm	Trail	gravel	*fixed counter*
				Jul 2014	N/A				Sunday		4pm	Trail	gravel	*fixed counter*
			5/23/2012	6/5/2012	3,797	14	271	355	Monday	25	9am	Trail	natural	*mobile counter*
	4	DRT (west side approaching the S. Canyon footbridge)	5/23/2012	6/5/2012	5,605	14	400	683	Sunday	45	10am	Bridge	gravel	*Rain 5/24-5/25*
	5	Larkspur Trail@Pilot Butte State Park	6/7/2012	6/12/2012	555	6	93	99	Fri/Sat	14	12pm	Trail	AC	*mobile counter*
	6	Coyner Trail near Bear Creek School		Mar 2015					Thursday		3pm	Trail	AC	*fixed counter*
				Feb 2015	2,563		92		Thursday		3pm	Trail	AC	*fixed counter*
				Jan 2015	2,764		89		Thursday		3pm	Trail	AC	*fixed counter*
				Dec 2014					Thursday		3pm	Trail	AC	*fixed counter*
				Nov 2014	1,898		63		Thursday		3pm	Trail	AC	*fixed counter*
				Oct 2014	3,872		125		Thursday		3pm	Trail	AC	*fixed counter*
				Sept 2014	4,346		145		Thursday		3pm	Trail	AC	*fixed counter*
				Aug 2014	2,889		93		Thursday		3pm	Trail	AC	*fixed counter*
				Jul 2014	2,869		93		Thursday		3pm	Trail	AC	*fixed counter*
			5/20/2014	5/26/2014	822	7	117	182	Friday			Trail	AC	*mobile counter*
			6/7/2012	6/12/2012	601	6	100	146	Friday	21	12pm	Trail	AC	*mobile counter*
	7	DRT (Farewell Bend Park @ boat launch)	6/16/2012	6/24/2012	5,141	9	571	1,277	Tuesday	61	5pm	Trail	paver	*mobile counter*
	8	DRT (Riverbend Park @ footbridge west end)	7/12/2014	7/16/2014	6,096	5	1,219	1,445	Tuesday			Bridge	wood	*mobile counter*
			6/16/2012	6/24/2012	7,379	9	820	1,056	Thursday	73	10am	Bridge	wood	*End of School*
	9	COID Trail near intake	6/27/2012	7/2/2012	482	6	80	116	Sunday	10	9am	Trail	gravel	*mobile counter*
	10	COID Trail connector to S. Canyon Br.	6/27/2012	7/2/2012	638	6	106	150	Sunday	11	9am	Trail	gravel	*mobile counter*
	11	DRT @ Colorado Dam take-out/portage location	7/12/2014	7/16/2014	5,942	5	1,188	1,795	Saturday			Portage	chip	*mobile counter*
			6/29/2013	6/30/2013	3,094	2	1,547	1,709	Sunday	265	4pm	Portage	chip	*mobile counter*
			7/4/2012	7/10/2012	10,246	7	1,464	2,556	Saturday	294	3pm	Portage	chip	*mobile counter*
	12	Drake Park Bridge (footbridge east)	7/1/2013	7/4/2013	6,552	3	496	5,561	Thursday	1,031	11am	Bridge	paver	*AVG excludes 4th of July*
			5/4/2013	5/8/2013	5,641	5	1,128	1,488	Saturday	122	6pm	Bridge	wood	*mobile counter*
			7/4/2012	7/10/2012	15,499	7	1,429	6,924	Wednesday	217	11am	Bridge	wood	*AVG excludes 4th of July*
	13	Pine Nursery Loop Trail (SE of kiosk)	7/11/2012	7/26/2012	825	13	63	100	Monday	8	9am	Trail	AC	*mobile counter*
	14	Pine Nursery Off Leash Area (E of entry gate)	7/11/2012	7/26/2012	1,271	13	98	140	Monday	19	8am	Trail	AC	*mobile counter*
	15	DRT @ Colorado Undercrossing (unimproved)	8/2/2012	8/14/2012	3,566	13	274	374	Saturday	29	3pm	Trail	natural	*mobile counter*
	16	DRT @ Carlon (Bill Smith Path)	8/2/2012	8/14/2012	7,105	13	547	670	Wednesday	44	9am	Trail	AC	*mobile counter*
	17	DRT @ Miller's Landing (south fence opening)	8/16/2012	8/21/2012	1,281	6	214	250	Friday	20	10am	Trail	AC	*mobile counter*
	18	DRT @ Portland (south approach)	8/16/2012	8/21/2012	490	6	82	172	Friday	17	12pm	Trail	paver	*mobile counter*
	19	DRT @ Riverbend Off-Leash Water Access	9/8/2012	10/3/2012	6,247	26	120	479	Saturday	30	1pm	Trail	AC	*divided by 2 for daily AVG*
	20	DRT @ Riverbend Off-Leash Area	9/8/2012	10/3/2012	10,313	26	397	685	Saturday	46	12pm	Trail	AC	*mobile counter*
	21	Colorado Bridge (east end)	5/6/2014	5/11/2014	10,912	6	1,819	3,736	Wednesday			Bridge	AC	*mobile counter*
			6/29/2013	7/2/2013	1,514	4	379	458	Sunday	45	3pm	Bridge	AC	*re-mounted higher to exclu*
			5/3/2013	5/7/2013	7,587	5	1,517	2,786	Friday	167	12pm	Bridge	AC	*hounted low enough to regi*
	22	DRT (east side at gate north of S. Canyon Bridge)	7/17/2014	8/27/2014	29,658	42	706	976	Saturday			Trail	gravel	*mobile counter*
			5/18/2013	5/27/2013	4,706	10	419	932	Saturday	70	12pm	Trail	gravel	*419 is AVG w/o PPP (914 c*
	23	DRT (east side upstream of Healy Bridge)		Apr 2015	18,897		629		Sunday		4pm	Trail	natural	*fixed counter*
				Mar 2015	19,263		621		Sunday		4pm	Trail	natural	*fixed counter*
				Feb 2015	11,255		402		Sunday		4pm	Trail	natural	*fixed counter*
				Jan 2015					Sunday		4pm	Trail	natural	*fixed counter*
				Dec 2014	6,633		216		Sunday		4pm	Trail	natural	*fixed counter*
				Nov 2014	7,378		246		Sunday		4pm	Trail	natural	*fixed counter*
				Oct 2014	12,666		409		Sunday		4pm	Trail	natural	*fixed counter*
				Sept 2014	16,432		548		Sunday		4pm	Trail	natural	*fixed counter*
				Aug 2014	21,645		698		Sunday		4pm	Trail	natural	*fixed counter*
				Jul 2014	21,910		706		Sunday		4pm	Trail	natural	*fixed counter*
			9/21/2013	9/22/2013	2,067	10	207	276	Monday	23	11am	Trail	natural	*mobile counter*

		5/10/2013	5/14/2013	2,819	5	564	752	Sunday	48	10am	Trail	natural	*mobile counter*
24	DRT (west side access at Mt. Bach Village)	5/18/2013	5/27/2013	1,607	10	161	277	Sunday	16	10am	Trail	gravel	*mobile counter*
25	DRT (west side upstream of Healy Bridge)	9/21/2013	9/22/2013	2,821	10	282	453	Saturday	33	10am	Trail	natural	*mobile counter*
		5/10/2013	5/14/2013	2,922	5	584	642	Saturday	58	9am	Trail	natural	*mobile counter*
26	Larkspur Trail @ US 20 Tunnel		Apr 2015	5,086		169		Monday		1pm	Trail	AC	*fixed counter*
			Mar 2015	4,862		156		Monday		1pm	Trail	AC	*fixed counter*
			Feb 2015	3,509		125		Monday		1pm	Trail	AC	*fixed counter*
			Jan 2015	3,667		118		Monday		1pm	Trail	AC	*fixed counter*
			Dec 2014	2,280		74		Monday		1pm	Trail	AC	*fixed counter*
			Nov 2014	2,677		89		Monday		1pm	Trail	AC	*fixed counter*
			Oct 2014	4,168		134		Monday		1pm	Trail	AC	*fixed counter*
			Sept 2014					Monday		1pm	Trail	AC	*fixed counter*
			Aug 2014					Monday		1pm	Trail	AC	*fixed counter*
			Jul 2014					Monday		1pm	Trail	AC	*fixed counter*
		5/20/2014	5/26/2014	1,498	7	214	264	Tuesday			Trail	AC	*mobile counter*
		7/4/2013	7/4/2013	174	1	174	174	Wednesday	12	10am	Trail	AC	*mobile counter*
		5/8/2013	5/8/2013	226	1	226	226	Wednesday	50	9am	Trail	AC	*mobile counter*
27	Shevlin Tumalo Creek Trail South		Apr 2015	4,492		149		Sunday		1pm	Trail	natural	*fixed counter*
			Mar 2015	4,566		147		Sunday		1pm	Trail	natural	*fixed counter*
			Feb 2015	3,778		135		Sunday		1pm	Trail	natural	*fixed counter*
			Jan 2015					Sunday		1pm	Trail	natural	*fixed counter*
			Dec 2014					Sunday		1pm	Trail	natural	*fixed counter*
			Nov 2014	3,310		110		Sunday		1pm	Trail	natural	*fixed counter*
			Oct 2014	5,454		176		Sunday		1pm	Trail	natural	*fixed counter*
			Sept 2014	4,495		150		Sunday		1pm	Trail	natural	*fixed counter*
			Aug 2014	6,404		207		Sunday		1pm	Trail	natural	*fixed counter*
			Jul 2014	7,197		232		Sunday		1pm	Trail	natural	*fixed counter*
		6/12/2014	6/22/2013	1,509	11	137	243	Wednesday			Trail	natural	*mobile counter*
		6/8/2013	6/21/2013	2,523	14	180	292	Tuesday	20	10am	Trail	natural	*mobile counter*
28	Fremont Meadow Bridge	6/8/2013	6/21/2013	1,324	14	95	194	Sunday	9	12pm	Bridge	natural	*mobile counter*
29	Haul Road Trail (west of Mammoth Dr.)		Apr 2015	2,703		90		Saturday		9am	Trail	gravel	*fixed counter*
			Mar 2015	2,712		88		Saturday		9am	Trail	gravel	*fixed counter*
			Feb 2015	1,877		67		Saturday		9am	Trail	gravel	*fixed counter*
			Jan 2015	1,844		58		Saturday		9am	Trail	gravel	*fixed counter*
			Dec 2014	1,398		45		Saturday		9am	Trail	gravel	*fixed counter*
			Nov 2014	1,420		47		Saturday		9am	Trail	gravel	*fixed counter*
			Oct 2014	1,913		62		Saturday		9am	Trail	gravel	*fixed counter*
			Sept 2014	2,391		80		Saturday		9am	Trail	gravel	*fixed counter*
			Aug 2014	3,563		115		Saturday		9am	Trail	gravel	*fixed counter*
			Jul 2014	3,590		116		Saturday		9am	Trail	gravel	*fixed counter*
		7/16/2014	8/27/2014	4,956	43	115	243	Saturday			Trail	gravel	*mobile counter*
		7/13/2013	7/18/2013	290	6	48	67	Saturday	11	11am	Trail	gravel	*mobile counter*
						78							
30	Haul Road Trail @ USFS	7/13/2013	7/18/2013	1,350	6	225	523	Thursday	65	11am	Trail	natural	*mobile counter*
31	Shevlin Park (Commons trailhead)	7/20/2013	7/28/2013	725	9	81	115	Sunday	22	8am	Trail	natural	*mobile counter*
32	Three Pines Trail @ Shevlin Commons	7/20/2013	7/28/2013	425	9	47	69	Sunday	15	10am	Trail	AC	*mobile counter*
33	Cascade Highlands Trail (east of Skyline Ranch)	5/20/2014	6/10/2014	1,295	22	59	182	Friday			Trail	natural	*mobile counter*
		7/30/2013	8/6/2013	153	8	19	27	Thursday	4	8am	Trail	natural	*mobile counter*
34	West Bend Trail (west of Skyline Ranch)	5/20/2014	6/1/2014	2,171	13	167	264	Tuesday			Trail	natural	*mobile counter*
		7/30/2013	8/6/2013	1,281	8	160	259	Saturday	15	2pm	Trail	natural	*mobile counter*
35	Alpine Trail (trail proper below rimrock)	8/9/2013	8/12/2013	20	4	5	12	Saturday	5	7pm	Trail	natural	*mobile counter*
36	First St. Rapids Bridge (west side)	8/16/2013	8/20/2013	888	5	178	247	Sunday	54	1pm	Bridge	gravel	*mobile counter*
37	Alpine Trail (west of Alpine Park towards Tetherow)	8/9/2013	8/12/2013	92	4	23	28	Saturday	7	1pm	Trail	natural	*mobile counter*
38	Sawyer Bridge (west side)	8/16/2013	8/20/2013	984	5	197	213	Tuesday	28	9-10am	Bridge	natural	*mobile counter*
39	DRT at base of hill accessing River's Edge GC	8/29/2013	9/5/2013	274	8	34	46	Sunday	16	9am	Trail	gravel	*mobile counter*
40	DRT at middle of hill accessing Mt. Washington	8/29/2013	9/5/2013	790	8	99	146	Monday	40	8am	Trail	natural	*mobile counter*
41	Gilchrist footbridge (east)	9/7/2013	9/16/2013	2,001	10	200	350	Saturday	58	9am	Bridge	natural	*mobile counter*
42	DRT on Riverfront Sidewalk @ Gilchrist	9/7/2013	9/16/2013	840	10	84	169	Saturday	40	9am	Sidewalk	AC	*mobile counter*
43	Coyner Trail @ Burnside	7/16/2014	8/27/2014	3,997	43	93	149	Thursday			Trail	AC	*mobile counter*
44	Coyner Trail @ Burnside & 10th	5/20/2014	5/26/2014	822	7	117	182	Friday			Trail	AC	*mobile counter*
45	DRT @ Archie Briggs	4/29/2014	5/4/2014	673	6	112	189	Saturday			Trail	AC	*mobile counter*
46	DRT @ Northcliff	5/20/2014	6/10/2014	3,726	22	169	264	Tuesday			Trail	AC	*mobile counter*
47	DRT North?	8/16/2014	8/27/2014	5,341	12	445	508	Monday			Trail	gravel	*mobile counter*

48	DRT Sawyer Uplands Connector	5/13/2014	5/18/2014	317	6	53	73	Saturday			Trail	gravel	*mobile counter*
49	Pine Nursery Disc Golf Course	5/6/2014	5/11/2014	294	6	49	67	Tuesday			Trail	AC	*mobile counter*
50	Shevlin Park (Tumalo Creek North)	7/18/2014	8/27/2014	1,910	41	47	86	Saturday			Trail	natural	*mobile counter*
51	Shevlin Park (Tumalo Creek South)	7/18/2014	8/27/2014	8,846	41	216	318	Saturday			Trail	natural	*mobile counter*
52	Shevlin Park (Upper Footbridge)	6/12/2014	6/22/2014	828	11	75	145	Thursday			Bridge	natural	*mobile counter*
53	West Bend Trail	8/16/2014	8/27/2014	1,738	12	145	195	Saturday			Trail	natural	*mobile counter*
54	West Bend Trail (north side)		Apr 2015	5,106		170		Saturday		3pm	Trail	AC	*fixed counter*
			Mar 2015	4,660		150		Saturday		3pm	Trail	AC	*fixed counter*
			Feb 2015	3,646		130		Saturday		3pm	Trail	AC	*fixed counter*
			Jan 2015					Saturday		3pm	Trail	AC	*fixed counter*
			Dec 2014	2,166		71		Saturday		3pm	Trail	AC	*fixed counter*
			Nov 2014	2,885		96		Saturday		3pm	Trail	AC	*fixed counter*
			Oct 2014	4,058		131		Saturday		3pm	Trail	AC	*fixed counter*
			Sept 2014	4,617		154		Saturday		3pm	Trail	AC	*fixed counter*
			Aug 2014	4,489		114		Saturday		3pm	Trail	AC	*fixed counter*
			Jul 2014					Saturday		3pm	Trail	AC	*fixed counter*
55	Shevlin Tumalo Creek Trail North		Apr 2015	962		32		Sunday		10am	Trail	natural	*fixed counter*
			Mar 2015	1,216		39		Sunday		10am	Trail	natural	*fixed counter*
			Feb 2015					Sunday		10am	Trail	natural	*fixed counter*
			Jan 2015					Sunday		10am	Trail	natural	*fixed counter*
			Dec 2014					Sunday		10am	Trail	natural	*fixed counter*
			Nov 2014	402		13		Sunday		10am	Trail	natural	*fixed counter*
			Oct 2014	937		30		Sunday		10am	Trail	natural	*fixed counter*
			Sept 2014	1,320		44		Sunday		10am	Trail	natural	*fixed counter*
			Aug 2014	1,578		51		Sunday		10am	Trail	natural	*fixed counter*
			Jul 2014	1,165		38		Sunday		10am	Trail	natural	*fixed counter*

Technical Memorandum #5.2:
Best Practices

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TRANSPORTATION ENGINEERING / PLANNING
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Technical Memorandum #5.2: Best Practices

Date: November 18, 2015 Project #: 17453.005

To: Jovi Anderson, Robin Lewis, Nick Arnis; City of Bend

From: Molly McCormick, Kelly Laustsen
Project: Bend Transportation Planning Strategy – Task 5: Multimodal Traffic Count Program
Subject: Technical Memorandum #5.2: Best Practices

This memo provides a summary of the current best practices for multimodal count programs and is intended to assist the City of Bend in researching, planning, and implementing a program. The state of the practice should be examined in order to provide background information and to allow the City of Bend to make an informed choice about methodologies, counting technologies, and data management. This will allow the city to understand how, when, and why certain technologies and methodologies are implemented based on current research and experience from other agencies. This memorandum also provides information on what tools and programs work best in what conditions.

The current state of the practice is summarized below in the following sections:

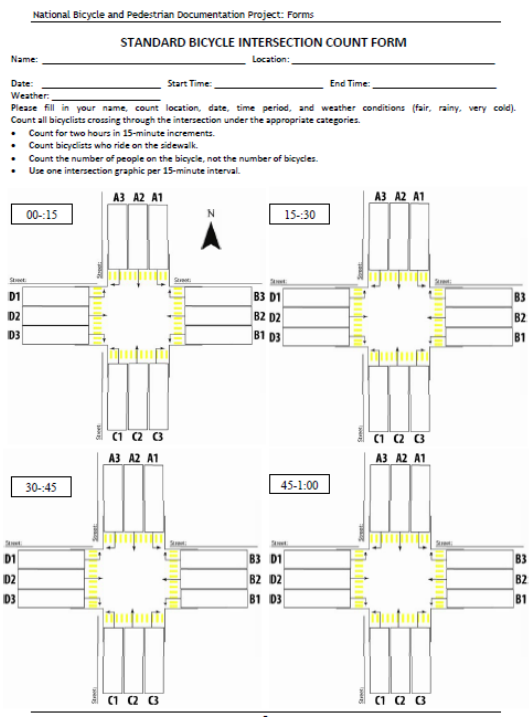
- Recent Research/Guidance on Data Collection Programs;
- Agency Examples;
- Data Applications;
- Counting Technologies;
- Data Management and Sharing
- Conclusion

RECENT RESEARCH/GUIDANCE ON DATA COLLECTION PROGRAMS

Multimodal data collection is a growing need and priority for agencies across the country, driven by a greater emphasis on multimodal performance measures and desire to serve all users. However, guidance on developing a multimodal data collection program is still limited. There is not a standard method for collecting, storing, or sharing data. Recent projects and publications aimed at starting to address the need for more guidance are discussed in the following sub-sections.

National Bicycle and Pedestrian Document Project (NBPD)

The National Bicycle and Pedestrian Document Project was started in 2004 and is led by Alta Planning + Design in collaboration with the ITE Pedestrian & Bicycle Council. It was one of the first attempts to create a repository for useful walking and bicycling data, including pedestrian and bicycle counts and survey data from multiple communities throughout the U.S. The following resources are available for practitioners establishing a data collection program:


National Bicycle and Pedestrian Documentation Project: Forms

STANDARD BICYCLE INTERSECTION COUNT FORM

Name: _____ Location: _____

Date: _____ Start Time: _____ End Time: _____

Weather: _____

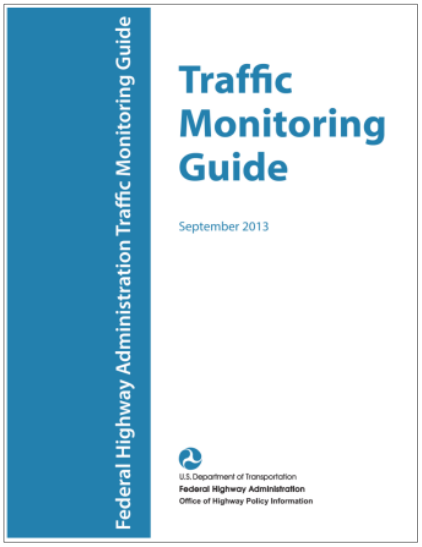
Please fill in your name, count location, date, time period, and weather conditions (fair, rainy, very cold). Count all bicyclists crossing through the intersection under the appropriate categories.

- 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.
- Use one intersection graphic per 15-minute interval.

- Materials and directions to conduct counts and surveys in a consistent manner (example count sheet shown to the right);
- Standard count dates and times;
- A location where this information can be sent; and
- A mechanism to make this information available to the public.

The NBPD has proposed a methodology for conducting manual volume counts and developed bicycle and pedestrian count and survey forms. The NBPD envisions that participating agencies and organizations will use the forms and methodology provided through the Project Description and Training Guidelines to conduct annual counts and surveys during the National Documentation Days in the second week of September. Supplementary data may be collected during set dates in January, May, and July to provide seasonal data.

2013 Traffic Monitoring Guide (TMG)



The Federal Highway Administration's (FHWA) Traffic Monitoring Guide provides guidance to agencies on collecting traffic-related data. Although the guide is focused on motorized traffic counting, the 2013 edition addressed non-motorized travel by adding "Chapter 4: Traffic Monitoring for Non-Motorized Traffic." The chapter includes a discussion of the key differences between monitoring for motorized and non-motorized traffic, outlines the process for developing permanent and short-term non-motorized data collection programs following the same steps discussed for motorized traffic, and introduces data codes to document different aspects of pedestrian and bicycle data collection. Chapter 4 also gives a brief explanation of each of the available bicyclist and pedestrian counting technologies and when each technology is most

appropriate to apply in a collection program.

The process recommended for developing permanent and short-term non-motorized data collection programs includes seven distinct steps:

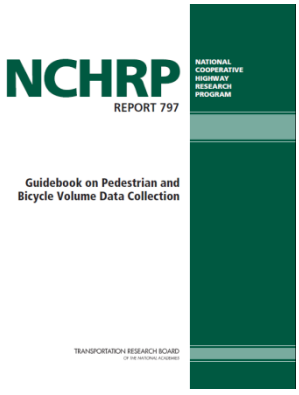
- Review the existing continuous count program;
- Develop an inventory of available continuous count locations and equipment;
- Determine the traffic patterns to be monitored;
- Establish pattern/factor groups;
- Determine the appropriate number of continuous monitoring locations;
- Select specific count locations; and
- Compute monthly, DOW, and hour-of-day (if applicable) factors to use in annualizing short-duration counts.

The TMG includes an appendix with a recommended data format for multimodal counts. The format includes data codes to document different characteristics of both the count location and count data, including direction orientation, road classification, type of facility, and approach and technology used to gather data. The intent of the format is to provide consistent with multimodal counts collected across the Country to provide more comparability.

NCHRP 797: Guidebook on Bicycle and Pedestrian Data Collection

NCHRP 797: Guidebook on Bicycle and Pedestrian Data Collection was published by the Transportation Research Board in 2014 to provide specific guidance for non-motorized data collection due to a previous lack in established national procedures and technology. The contents of the guidebook include:

- Count applications with case studies;
- Planning and implementing a count program, with checklists and case studies;
- Correcting raw count data for to account for site- and product-specific counting errors;
- Expanding short-term count data to estimate longer-duration volumes; and
- Typical applications, strengths/limitations, relative cost, installation needs, and accuracy of counting technologies.



The Guidebook includes the following sections:

- **Quick Start Guide** – This section highlights the key information discussed in each guidebook chapter to help readers quickly find the material that is of greatest importance to them.

- **Introduction** – The first chapter of the guidebook describes its organization, summarizes the research that led to the development of the guidebook, discusses what is and is not covered in the guidebook, and gives an overview of non-motorized counting concepts.
- **Non-Motorized Count Data Applications** – The second chapter of the guidebook provides examples from real-world count program practitioners to demonstrate the many ways non-motorized count data can be applied to improve the performance of transportation organizations. The most common uses of non-motorized count data was
    - Tracking changes in pedestrian and bicycle activity over time;
    - Evaluating the effects of new infrastructure on pedestrian and bicycle activity;
    - Prioritizing pedestrian and bicycle projects;
    - Modeling transportation networks and estimating annual volumes; and
    - Conducting risk or exposure analyses.
- **Data Collection Planning and Implementation** – The third chapter of the guidebook describes the steps involved in starting and expanding a non-motorized count program. The steps outlined for planning a count program include:
    - Specifying the data collection purpose;
    - Identifying data collection resources;
    - Selecting count locations and the count timeframe; and
    - Considering available counting methods and technologies.

  The steps outlined for implementing the count program include:
    - Obtaining necessary permissions;
    - Procuring counting devices;
    - Taking inventory and preparing devices;
    - Training staff;
    - Installing and validating devices;
    - Calibrating devices;
    - Maintaining devices;
    - Managing count data;
    - Cleaning and correcting count data; and
    - Applying count data.
- **Adjusting Count Data** – The fourth chapter of the guidebook discusses two types of factors, correlation and expansion, that can be applied to count data when developing volume estimates.

- Correction factors are developed from validation counts and account for systematic inaccuracies in counter technology. These factors are used to adjust raw counts to more closely represent the ground truth.
- Expansion factors are applied specifically to short-duration counts to estimate volumes over longer periods of time.

- **Sensor Technology Toolbox** – The last chapter of the guidebook summarizes 14 existing and emerging technologies available for non-motorized counting. Each technology is presented in its own subsection including a description, typical applications, installation considerations, relative level of effort and cost, strengths and limitations, accuracy, and current usage. The existing and emerging counting technologies and methods included are:
  - Manual in-field counting;
  - Manual counts from video;
  - Automated counts from video;
  - Pneumatic tubes;
  - Inductive loop detectors;
  - Passive infrared;
  - Active infrared;
  - Piezoelectric strips;
  - Radio beams;
  - Thermal;
  - Laser scanners;
  - Pressure and acoustic pads;
  - Magnetometers; and
  - Fiberoptic pressure sensors.

AGENCY EXAMPLES

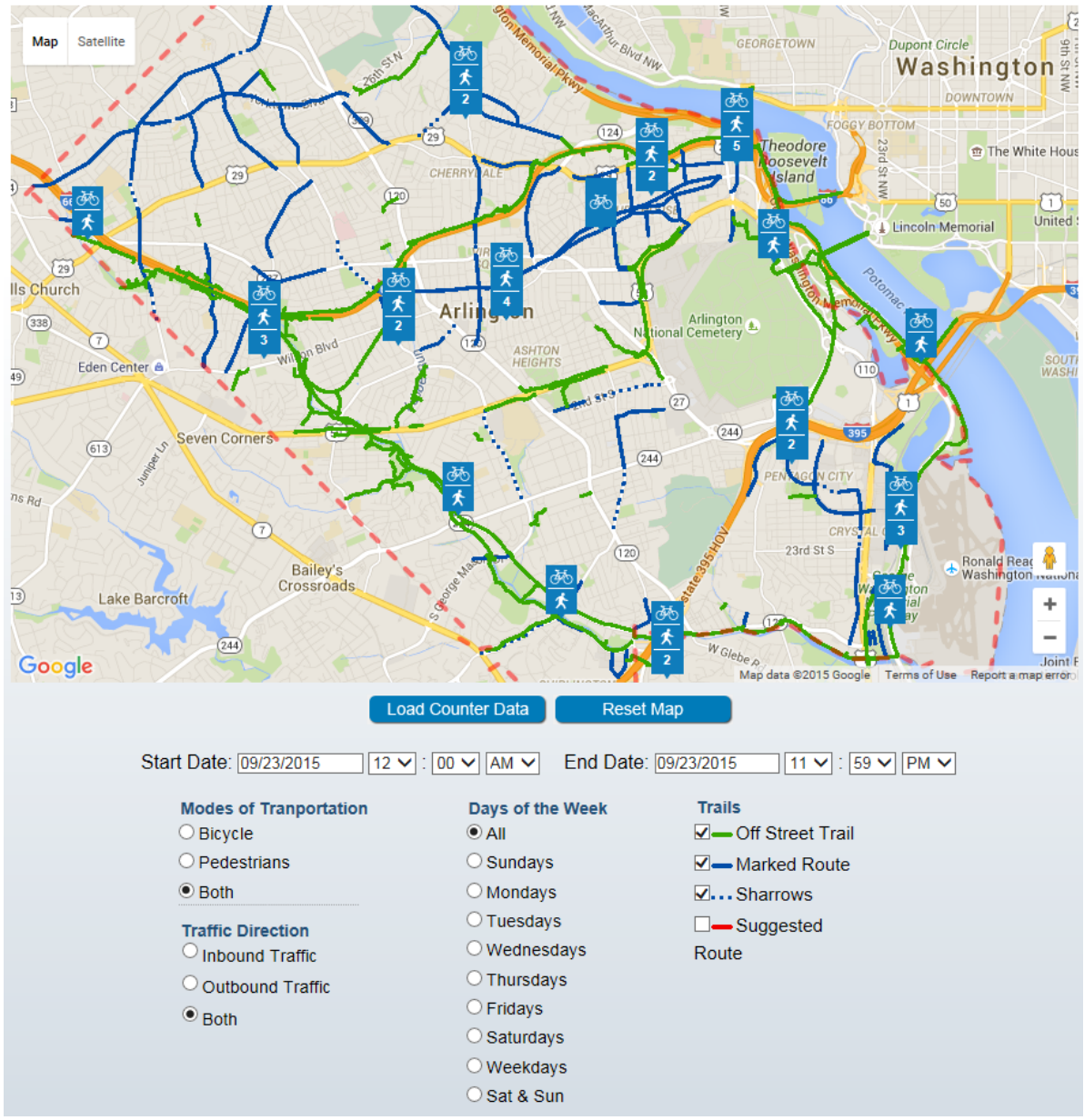
As part of the research associated with NCHRP 797, agency surveys and interviews were conducted to assess the state of the practice for bicycle and pedestrian data collection and identify agencies with particularly robust multimodal data collection programs. The following agencies provide example data collection programs the City of Bend can review to help determine what elements of other programs may be applicable to them. These examples illustrate the range of data collection technologies, data applications, data storage system, and multimodal reports that Bend may choose to emulate or build from.

BikeArlington

BikeArlington is a bicycling-enthusiast program that works to get more people in the Arlington, Virginia area on their bikes. A count program is included through Arlington County to provide data for any interested agencies to use. Continuous automatic counters are maintained in the area to collect bicycle and pedestrian volumes throughout the day. There are currently 32 permanent count locations and 6 portable counters used in the county. The types of counters included are passive infrared and inductive loops, used separately and in combination.

To display the data collected by the counters, BikeArlington has a Bicycle & Pedestrian Counter Dashboard where volumes of bicyclists and/or pedestrians are shown for the selected location during the selected time period. Exhibit 1 shows how the counter dashboard is displayed online. The data is also available to be downloaded in a spreadsheet format.

Exhibit 1. BikeArlington Bicycle & Pedestrian Counter Dashboard



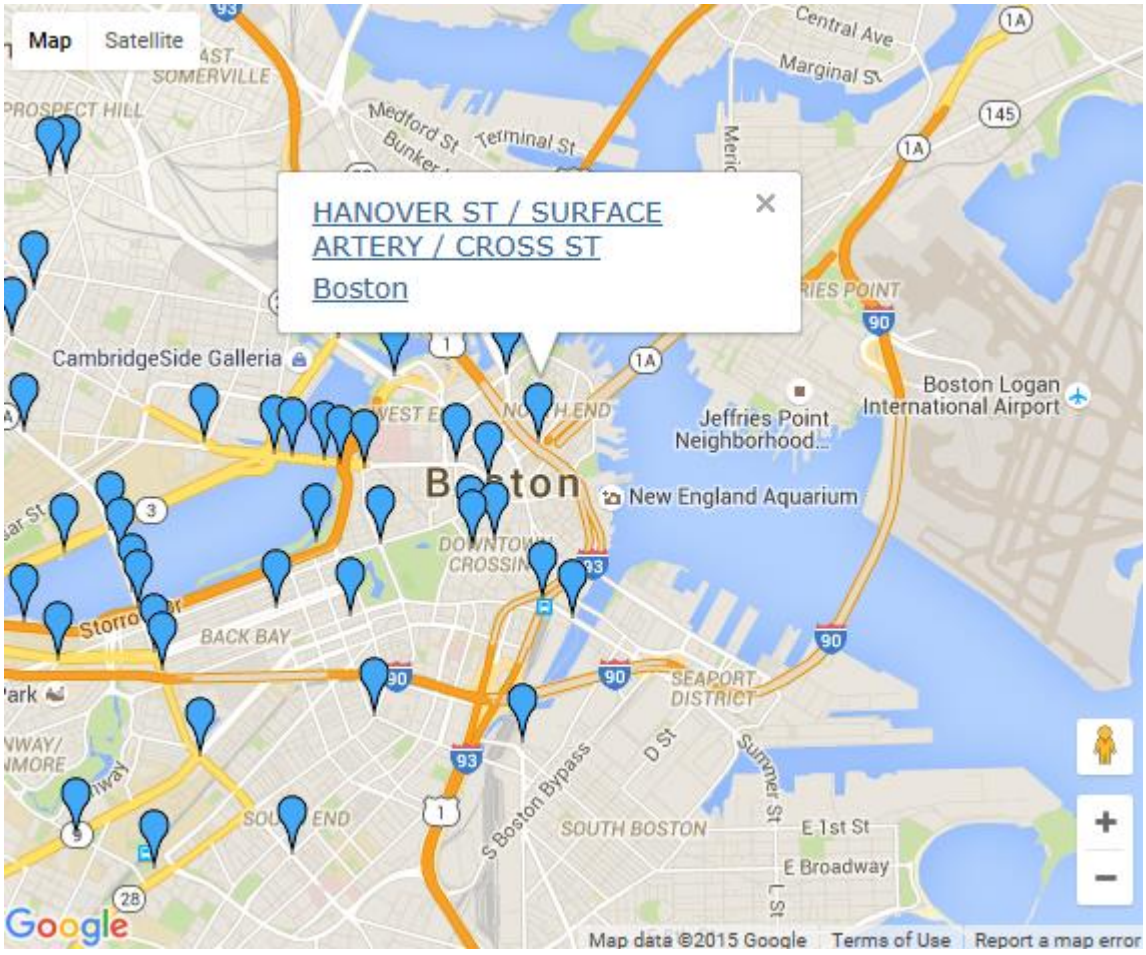
Source: BikeArlington (2015)

Boston Region Metropolitan Planning Organization

The Boston Region Metropolitan Planning Organization manually collects annual pedestrian and bicycle volume counts every year, dating back to 1976. 71 facilities from the Boston region are included in the count database.

Exhibit 2 shows how the database is displayed online. The individual location information and count data can be downloaded in spreadsheet format.

Exhibit 2. Pedestrian and bicyclist count database display online



Source: Boston Region Metropolitan Planning Organization (2015)

Portland Bureau of Transportation

The Portland Bureau of Transportation (PBOT) collects a variety of multimodal data, which is collected and managed by a number of different people in different divisions of PBOT. The city is most reliant on the manual 2-hour counts conducted by volunteers. The city does a large effort to collect bicycle counts every summer (they collected data at about 240 sites this year), with the database going back about

fifteen years. More information about the summer bike count, including locations and count forms, is available online here: tinyurl.com/pdxbikecounts

In addition, the city collects pedestrians and bicycle data in September as part of the National Bicycle and Pedestrian Documentation project, which they've been collecting for about the past five years. These counts primarily include locations on the trail system. More information is available online here: tinyurl.com/pdxtrailcounts. The city hopes to do more targeted pedestrian counting in the future.

Exhibit 3 shows an example count sheet to collect user characteristics and volumes used by PBOT, similar to forms used as part of the National Bicycle and Pedestrian Document Project. Non-motorists are split into categories based on mode and gender, including wheelchair and other categories. This information is used for several purposes from supporting projects within the area to providing data to the NBPDP. The information collected is provided in an annual report.

Exhibit 3. Example Portland Bureau of Transportation Counting Sheet

STANDARDIZED TRAIL COUNT FORM

THE INTER TWINE

Site ID: 065 Trail Name: Springwater Corridor Location: SE 82nd Avenue
To be completed by Data Collector: Date: 9.11.12 Time Period: 5-7pm Weather: warm, windy
Name of Data Collector: John Smith Notes:

	Bicycles		Pedestrians		Wheelchairs		Others	
	Female	Male	Female	Male	Female	Male	Female	Male
:00-:15	|| 2	𝍸 || 12	|||| 4	|| 2				
:15-:30	||| 3	𝍸 || 12	ø	|||| 4				1 1
:30-:45	|| 2	𝍸 𝍸 𝍸 20	|| 2	|| 2		1 1		
:45-1:00	𝍸 | 6	𝍸 𝍸 || 17	ø	1 1				|| 2
1:00-1:15	ø	𝍸 𝍸 |||| 14	ø	|| 2				
1:15-1:30	ø	𝍸 𝍸 ||| 13	1 1	1 1			1 1	
1:30-1:45	|||| 4	𝍸 𝍸 10	1 1					
1:45-2:00	𝍸 | 6	𝍸 𝍸 𝍸 𝍸 || 22	1 1	||| 3				
Total 172	23	120	9	15		1	1	3

Source: Portland Bureau of Transportation (2012)

Portland is experimenting with the "Honey Bee" bike counter developed by Knock Software, which is a wireless sensor that transmits the data to the cloud via bluetooth. The sensor is still being refined by Knock to distinguish between users and will continue to be tested and refined for the next few months.

The device detects distortions in the magnetic field and uses an infrared camera to measure the heat pattern of a human. Combined with a speed calculation, the counter is intended to distinguish between vehicles, bikes, and pedestrians. The counter is anticipated to much cheaper than other counting devices. In addition, Portland is helping Knock test its ride tracking app, Ride. The intent of the app is to track rides and provide a picture of where people are riding and how comfortable they feeling when riding. In addition, those with the app will eventually be the people to transmit the count data from the sensor box to the cloud. More information on the app and a stress map from the data collected in Portland is available online: https://ride.report/.

Portland is currently experimenting with using loops at signals that allow bicyclists to call for a green signal while counting riders. The loops are intended to distinguish between motor vehicles and bicyclists. Testing has shown that inductive loop technology is capable of detecting bicyclists on shared roadways with relatively high accuracy, but under and overcounts do occur.

Lastly, Portland uses pneumatic tube counters on bike only facilities and mixed traffic areas. For bike only facilities, the city uses Eco Counter's tubes, which can work in mixed traffic as well but do not report data on vehicles. In mixed traffic areas, they city uses JAMAR Cycle plus, which produces a wide variety of reports including speed, volume, and class which gives the city more flexibility to work with the data.

COMPASS IDAHO

The Community Planning Association of Southwest Idaho (COMPASS) is an association of local governments that works on planning for the Treasure Valley. COMPASS has a lead bicycle and pedestrian planner and also an Active Transportation Workgroup to advise COMPASS on regional bicycle and pedestrian planning efforts. In order to inform bicycle and pedestrian planning for the area, COMPASS worked to develop a comprehensive data collection program. The program includes data for permanent and portable counters, as well as manual counts and Strava data. COMPASS provides installation and data collection services to member agencies for temporary bicycle and pedestrian counting. COMPASS uses the following:

- Pneumatic tubes from JAMAR (TRAX Cycles Plus) – measures speed, direction, and count of bicyclists on road, powered by internal battery pack.
- Pneumatic tubes from Eco-Counter (Tube Cyclist Counter) – measures direction and count of bicyclists, powered by internal battery pack.
- Infrared sensor from Eco-Counter (PYRO Box) – measures direction and counts of pedestrians on or off road, powered by an internal battery pack, mounted to nearby vegetation or post.
- Video counts from Day6 Outdoors (Plot Watcher Pro Time-Lapse HD Video Camera) – provides time-lapsed video for calibrating bicycle and pedestrian counts.

DATA APPLICATIONS

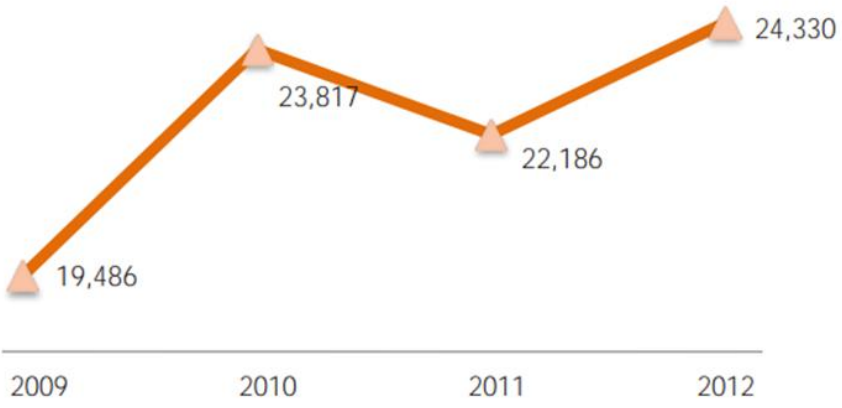
Multimodal data can be used for a number of applications. This section provides a list of potential applications with relevant case studies. This material is largely drawn from NCHRP 797, which features a chapter of data applications.

Measure Facility Usage

Collecting consistent multimodal data at set locations and regular intervals can aid in measuring facility usage and changes over time. This is helpful for tracking progress towards established goals and measuring success. Particularly as agencies move towards more multimodal performance goals, data on bicyclists, pedestrians, and vehicles is important to monitor a transportation system. If counts are collected at a regular time each month or year, trends over time can be assessed and metrics like percentage of users biking or walking or total bicyclists and pedestrians using a facility can be tracked.

Exhibit 4 shows an example graph from Washington State DOT, which uses a regular count program to monitor bicycling and walking activity. The state has set goals for bicycling and walking and uses data collected each year to assess progress.

Exhibit 4. Change in walking and bicycling activity at Washington State count sites, 2009–2012



Source: Washington State DOT (2012)

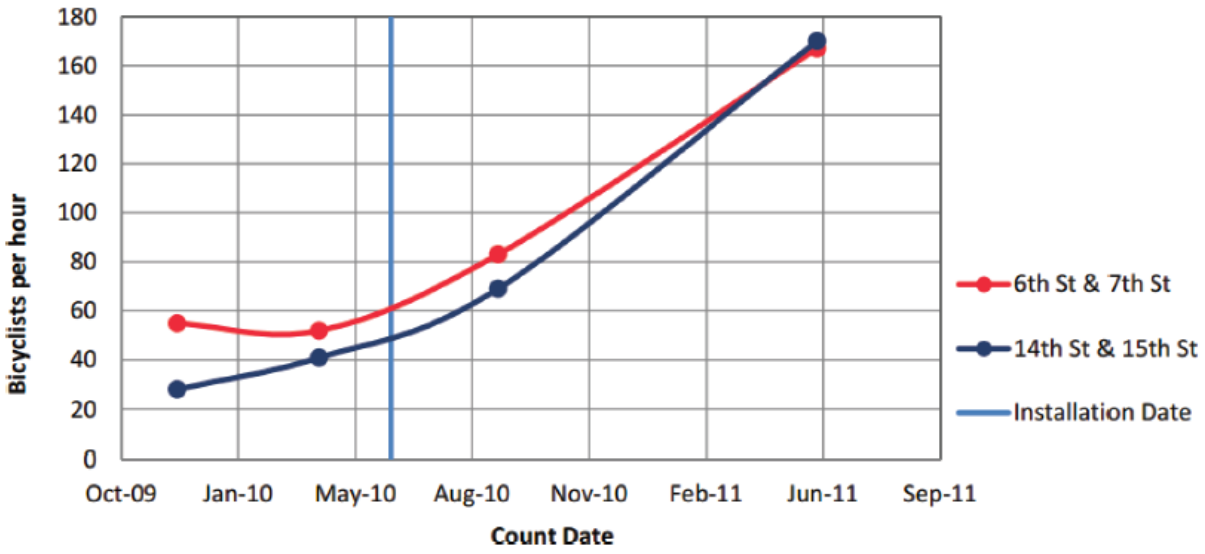
Evaluate Before & After Volumes

By collecting multimodal data before and after a new facility is opened or improvement to a facility made, volume changes can be measured and conclusions about the success of the facility can be made. It is valuable to track these changes because they can be later used to forecast usage of planned facilities or to justify additional improvements based on past results.

Exhibit 5 shows an example graph of before-and-after bicycle facility usage from the District Department of Transportation in Washington, DC (DDOT). DDOT used before-and-after counts to

access the change in bicycle volumes after buffered bicycle lanes were added in the center median of Pennsylvania Avenue. The significant bicycle volume increase seen after the installation could be used to demonstrate project success, support similar treatments in the future, and forecast future bicycle activity for planning future treatments.

Exhibit 5. Before-and-after bicycling activity at two improvement sites in Washington, DC, 2009-2011



Source: Kittelson & Associates, Portland State University, and Tool Design Group (2012)

Analyze Safety

By including non-motorized counts in safety analysis for a facility or area, before-and-after safety effects can be identified for new facilities or upgrades and exposure can be quantified. Exposure generally refers to an estimate of the potential for conflict to occur and can be applied to both pedestrians and bicyclists. Exposure is a component of risk and is defined as the probably that a physical conflict will occur. Exposure is only one of the factors that contribute to risk. One method proposed for estimating exposure is to consider crash data compared to user volumes. For example, pedestrian exposure could be assessed by considering the number of crashes compared to the number of pedestrians using a facility or the number of pedestrian users multiplied by the number of vehicle users. If only the number of crashes was taken into account, the non-motorist exposure would not be linked to the number of users on a facility and could misconstrue where risk is the highest. Non-motorized counts are therefore important for analyzing safety by leading to better evaluations of risk and crash data that are not solely based on the number of crashes reported at a location.

An example of safety analysis using non-motorized counts is provided by Montreal, Quebec. 647 signalized and 435 unsignalized intersections were evaluated by Strauss, Miranda-Moreno, and Morency (2014) to estimate the correlation between non-motorist injuries and intersection demand or intersection characteristics. For instance, models were developed to determine the percentage

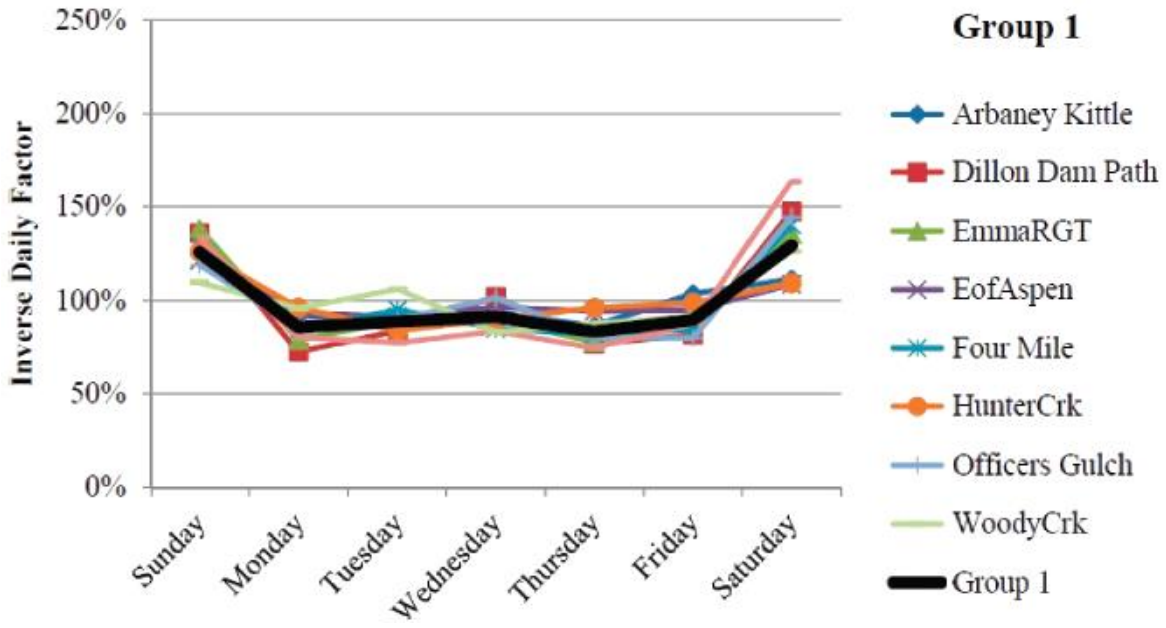
increase of pedestrian or bicyclist injuries due to percent increase of vehicle volumes at signalized or unsignalized intersections, respectively.

Identify User Characteristics

Count data that expresses user characteristics can be used to better explain what drives mode choice and whether certain characteristics are more influential than others for increasing non-motorized travel. Agencies can use this information to guide policies, access performance goals, and prioritize facility improvements and future projects. In addition, recording user characteristics like wrong-way riding or sidewalk riding can help identify high-priority facility gaps where demand is present.

Exhibit 6 shows an example graph of how pedestrian and bicyclist volumes can be used to identify user characteristics from the Colorado Department of Transportation. Count data was used to identify three trail usage patterns using cluster analysis: Mountain Non-Commute, Front-Range Non-Commute, and Commute. Each pattern was associated with certain trip purposes and activities. By establishing three user patterns, CDOT was able to more accurately extrapolate short-term volumes to annual trail user volumes.

Exhibit 6. Colorado DOT commute trail factor group



Source: Nordback Marshall, Janson (2013)
Note: Inverse daily factor is the percentage of the average daily volume observed on each specific day. Each legend item represents a different bicycle monitoring location. The bold line is the average of all locations.

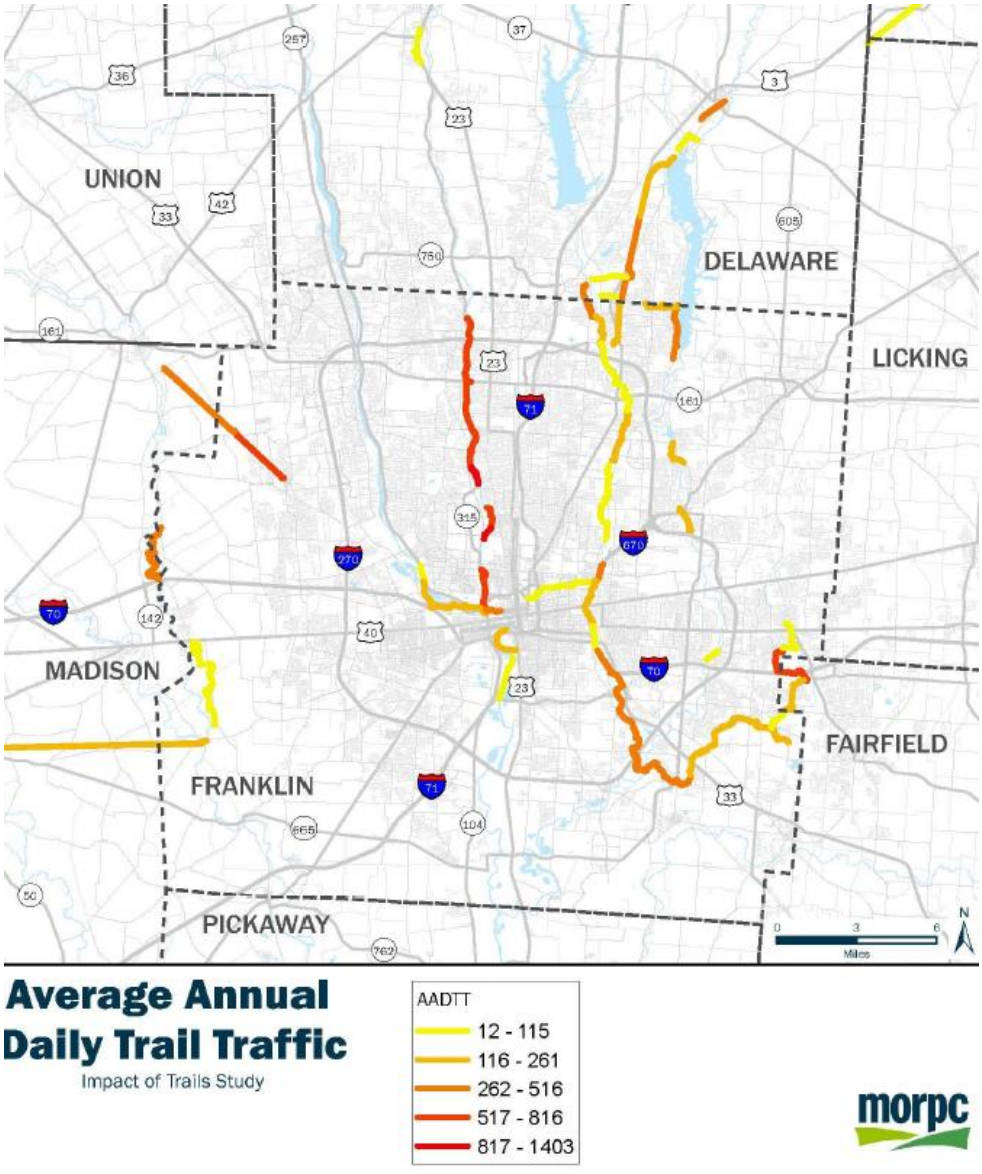
Estimate Network Volumes

Multimodal count data can be aggregated to estimate the pedestrian and bicyclist volumes across a network. Tracking network volumes helps to prioritize future improvements or projects within a region.

It is also valuable for forecasting future usage in the network or for comparing the change in volumes with different proposed improvements. As with measuring facility usage, estimating network volumes is important for monitoring a transportation system and measuring multimodal usage goals.

Exhibit 7 shows a map-based example of network volumes estimated using both short-term and long-term counts from the Mid-Ohio Regional Planning Commission (MORPC) and local partners, including the City of Columbus and the Rails to Trails Conservancy. The MORPC has been monitoring trail traffic for the last several years and producing reports to describe the results. As seen in the figure, a trail network is present and has ranging usage depending on corridor.

Exhibit 7. Estimated annual trail volumes



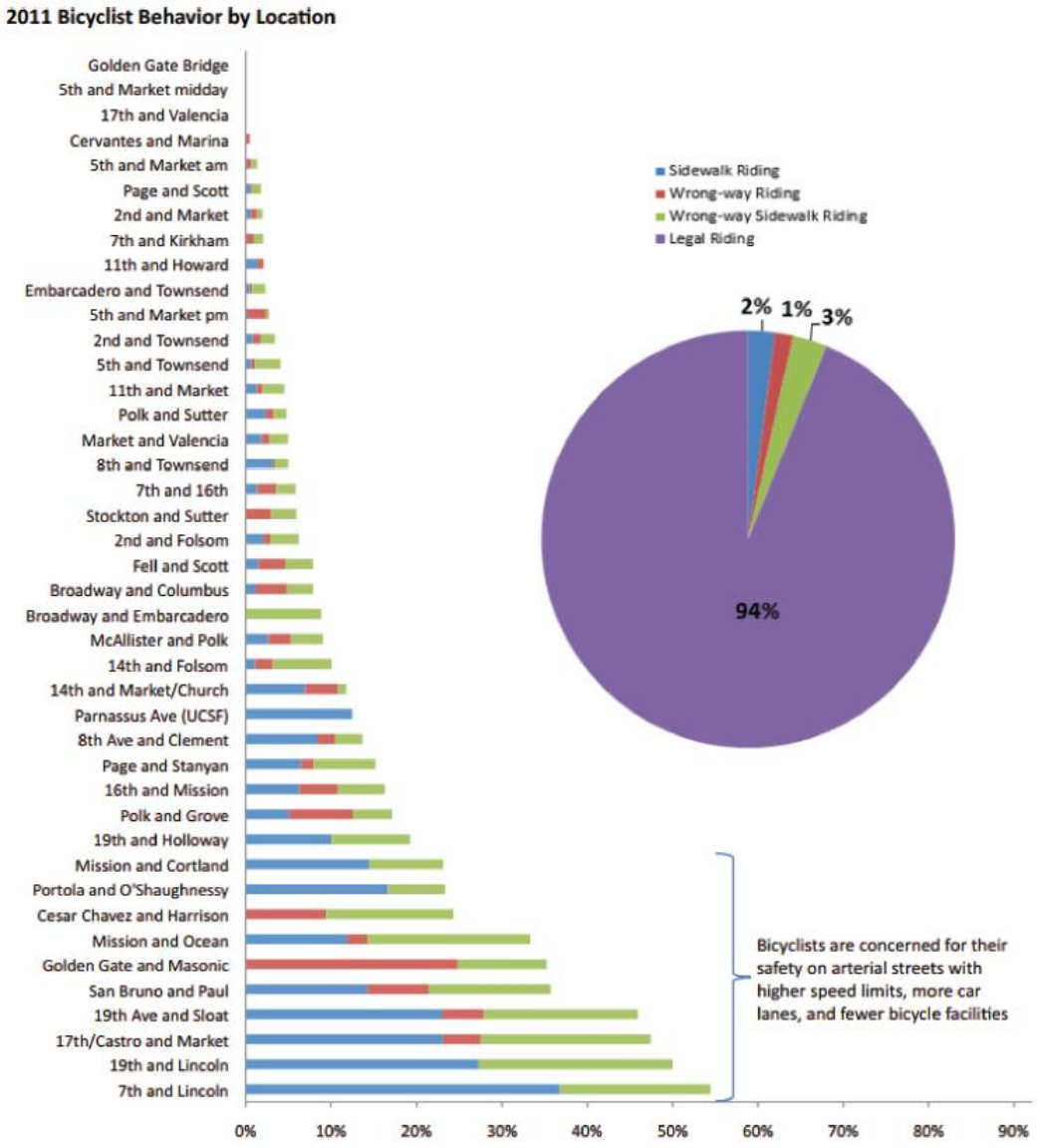
Source: Mid-Ohio Regional Planning Commission (2015)

Prioritize Projects

Agencies can use non-motorized counts to help prioritize improvement locations and multimodal networks and to determine projects that have the highest potential to influence walking and bicycling rates. Pedestrian and bicycle volumes can identify the facilities where improvements can have the greatest impact and improve already essential multimodal networks. Counts can also expose areas where improvements may be needed due to deficiencies that result in improper user behaviors (like wrong-way and sidewalk riding).

Exhibit 8 shows an example figure from the San Francisco Municipal Transportation Agency (SFMTA) that shows rates of wrong-way and sidewalk riding for bicyclists at different locations in San Francisco. A total 6% of bicyclists were observed improperly using the facilities. The report from SFMTA concludes that improper riding most frequently occurs when the location has higher speeds, more car lanes, and fewer bicyclist facilities, as shown in the figure.

Exhibit 8. Use of manual counts to evaluate unsafe bicyclist behaviors



Source: San Francisco Municipal Transportation Agency (2011)

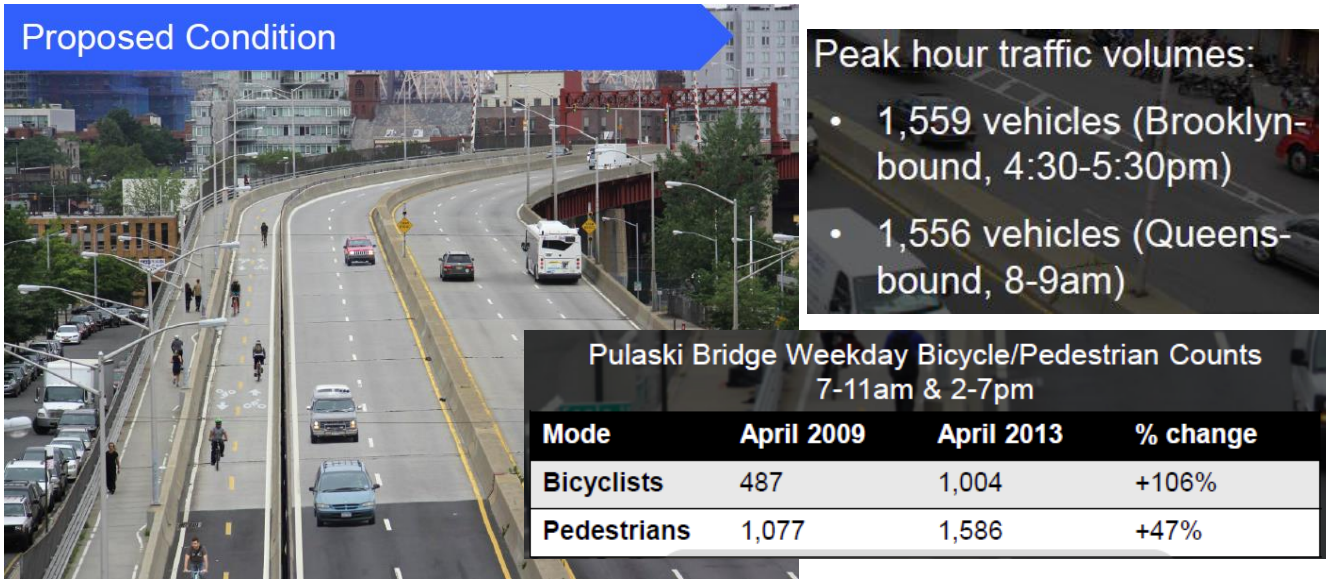
Assess Mode Split

Collecting multimodal data can be used to assess mode split on a roadway and better understand the balance of users. This can be used to better define priorities on a roadway and assess what facilities are most appropriate. For example, collecting vehicle and bicycle data on a roadway could help inform the decision to install enhanced bicycle facilities, like a buffered bicycle lane or cycle track. In addition, tracking mode split over time could help assess the impact of improvements made aimed at impacting mode split by encouraging walking or bicycling.

As shown in the example from New York City, collecting data on bicycle, pedestrian and vehicle volumes on a roadway can help determine the most appropriate cross-section and evaluate the

feasibility of improvements. The City collected counts of all users on the Pulaski Bridge to help assess potential improvements and ultimately recommend replacing a travel lane with two-way bicycle lanes.

Exhibit 9. Proposed condition on Pulaski Bridge justified by multimodal traffic counts



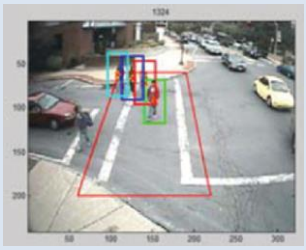
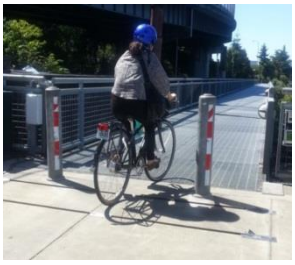
Source: New York City Department of Transportation (2013)

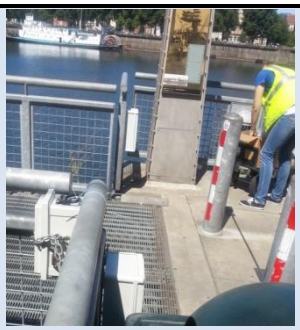
COUNTING TECHNOLOGIES

There are a variety of technologies for counting vehicles, pedestrians, and bicyclists currently available, and a number of products still under development. Based on the count location and duration, as well as metrics desired (i.e. volume of bicyclists, volume of pedestrians, directionality, helmet use), different technologies may be appropriate for different locations. Chapter 5 of NCHRP 797 provides a toolbox of technologies, with typical applications, considerations, images, and other key information provided on each technology. However, because the industry is moving so quickly, this information should serve as a starting point. Improvements in these technologies are anticipated and new technologies are entering the market. A table below is provided summarizing some of the most common data collection technologies.

Table 1. Data Collection Technologies

Technology	Data	Typical Applications	Considerations
Manual counts 	• Intersection turning movement counts or screenline counts • Pedestrians, vehicles, and/or bicyclists • Demographic data or user characteristics	• Short-term counts • Counts where demographic or user data is desired • Instances where counts are needed at many locations	• Longer-term counts can be expensive. • Data can be counted live or reduced from video. Quality tends to decrease when individual is counting for a longer period of time or responsible for counting a large number of variables.

Automated video counts 	• Intersection turning movement counts or screenline counts • Pedestrians and/or bicyclists	• Short-term counts • Can be used for up to 1 week at a time • Video can be used for additional purposes	• Multiple cameras to collect data from an entire intersection. • Some data storage limitations. • Cameras need to be mounted high enough to capture the desired area. • Should try to use existing infrastructure for mounting but avoid sources of vibration • Not currently possible to process video in-house – algorithms still being further developed
Passive infrared 	• Screenline counts • Pedestrians or bicyclists	• Long-term or permanent counts • Often combined with inductive loops or piezoelectric strips in integrated units • Multi-use paths or sidewalks	• Sensor is located on one side of facility • Not able to differentiate between pedestrians and bicyclists. • Best for facilities with one user type or in conjunction with another technology to differentiate users. • Placement of counter is important for good results. • Subject to occlusion errors. • Results can be affected by extreme temperatures. • Can undercount pedestrians, especially as pedestrian volumes increase • Good mobility; can be taken to a new site
Active infrared 	• Screenline counts • Pedestrians or bicyclists	• Temporary or permanent counts • Often combined with inductive loops or piezoelectric strips in integrated units • Multi-use paths or sidewalks	• Infrared beam is between a transmitter and a receiver facing each other on opposite sides of facility. • Need a clear line of sight between transmitter and receiver • Not able to differentiate between pedestrians and bicyclists. • Best for facilities with one user type or in conjunction with another technology to differentiate users. • Subject to occlusion errors. • Good mobility; can be taken to a new site • Is fairly accurate although can count false positives if objects interfere with the infrared beam
Pneumatic tubes 	• Screenline counts • Vehicles and/or bicyclists • Speed and directionality (when using two tubes)	• Short-term or long-term counts • Paved surfaces	• Should be located where bicyclists are not likely to stop. • Work best when temperatures are above freezing • Most jurisdictions are already familiar with this technology due to high use with motorized traffic • Subject to undercounting error.
Radio beam	• Screenline counts • Pedestrians and/or bicyclists	• Short-term or long-term counts • Multi-use paths or sidewalks	• Radio beam is between a transmitter and a receiver facing each other on opposite sides of facility. • Need a clear line of sight between

			transmitter and receiver • Subject to occlusion errors. • Narrow recommended maximum separation between transmitter and receiver • Good mobility; can be taken to a new site • Has not been widely used by jurisdictions
Inductive loops 	• Screenline counts • Vehicles and/or bicyclists	• Temporary or permanent counts • Normally on paved facilities	• Shown to work best where bicycles are separated from motorized traffic. • Should be located where bicyclists are not likely to stop and are more likely to travel single file • Considerable lead time might be required to install embedded loops • Most jurisdictions are already familiar with this technology due to high use with motorized traffic

DATA MANAGEMENT AND SHARING

Having an efficient, robust system to enter, store, and share counts is important to make sure that count data is easily available to those that need it. Consistently collecting and storing data helps ensure that the data is reliable and comparable over time. Key steps in developing a system to manage and share data include:

- **Determine key metrics** that should be counted and collected. The TMG provides recommended metrics as well as optional metrics for consideration, like demographic data.
- **Establish a consistent reporting format** to ensure data is comparable over time. A consistent data collection methodology helps make sure results are easily comparable. The data format provided in the FHWA Traffic Monitoring Guide should serve as a base.
- **Provide public access to count data** through an online database, downloadable spreadsheets, and/or annual reports. This will help ensure the use of the data and maximize the return on investment.
- **Visualize count data** through bar charts, maps and graphics. There are several examples of databases that use GIS to illustrate patterns and trends.

As referenced above, FHWA has developed a format for multimodal data collection and is currently developing formal repository for these data within its Travel Monitoring Analysis System (TMAS) 3.0. Data must meet certain standards, including basic information about the count location, type of count (pedestrian or bicycle), direction of travel, time, count interval, and method of counting to be included in the system. The intent of the system is to make data accessible and enable comparisons over time and across the United States.

Examples of data management and sharing programs from agencies across the county are provided below.

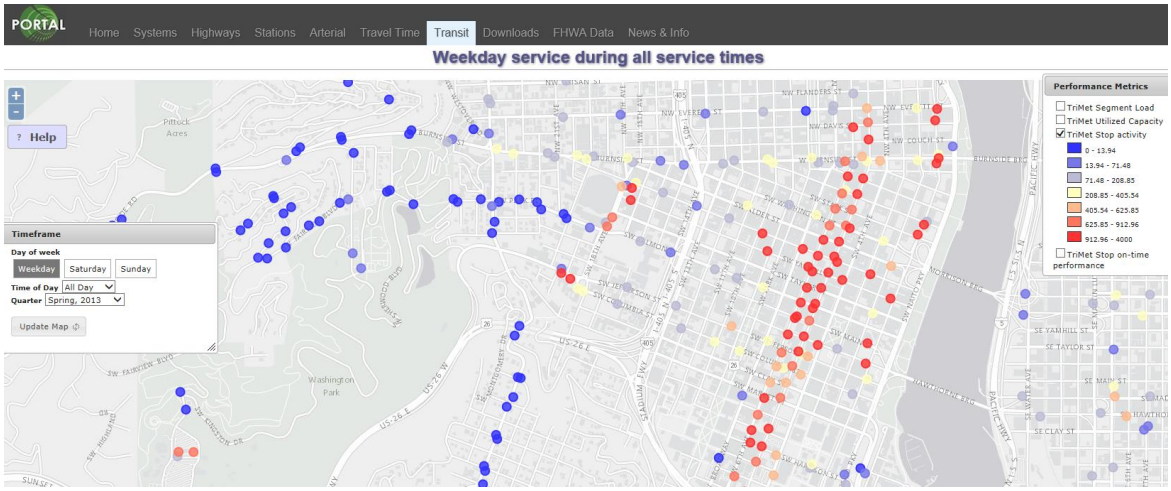
Portland State PORTAL System

Portland State University, in partnership with Metro, Oregon Department of Transportation, Regional Transportation Council, and FHWA, provides a great data management and sharing program through PORTAL. It is an online database where any interested party can view collected data for the highway, arterial, and transit networks within the Portland metropolitan area in Oregon. PORTAL has current data available for the roadway network including live traffic speeds, average speeds over the last 5 weekdays, daily vehicle miles traveled (VMT), and a travel time calculator. In terms of non-motorized traffic, transit information is available to show TriMet stop activity, stop on-time percentage, utilized capacity, and segment load. As of October 2015, the most recent TriMet data available is from summer 2013. Most of the information provided through the site is map-based or graphical and certain time intervals can be specified for examination.

Exhibit 10 shows an example of how data is portrayed on the PORTAL website through maps illustrating the weekday stop activity for spring 2013 in downtown Portland. Exhibit 11 shows another example from the PORTAL website of a graphical summary of highway I-5 in the northbound direction for the morning of October 5, 2015.

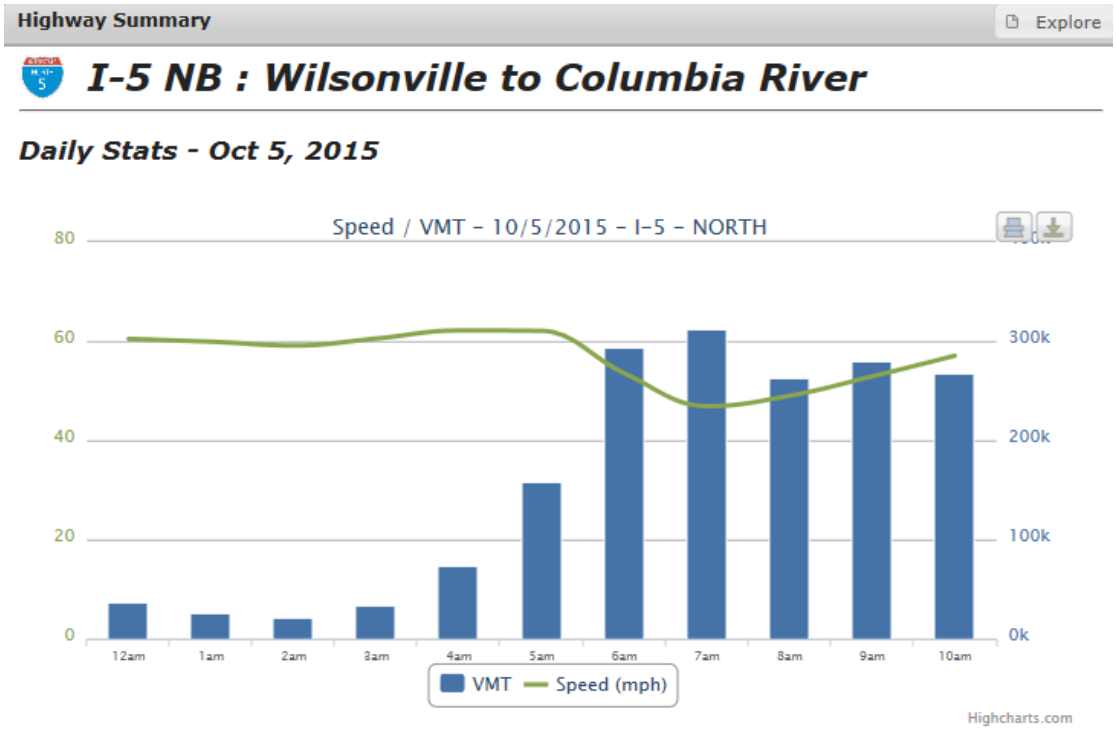
Additionally, a demonstration website is accessible to see how the PORTAL system could be used for pedestrian and bicyclist count data. Data is available from December 2011 to December 2012 for pedestrian volumes and from May 2012 to May 2013 for bicycle volumes. As with the TriMet database, the pedestrian and bicyclist data can be searched by date, time, and day of the week. Figure 11 shows an example from the demo PORTAL website of pedestrian search. This data is estimated from pedestrian pushbutton actuations at crossings. This limits the count locations to 7 crossings equipped with pushbuttons. Figure 12 shows a bicycle search from the demonstration database. Uni-directional bicycle volumes were collected at 16 locations.

Exhibit 10. Example of PORTAL transit database online



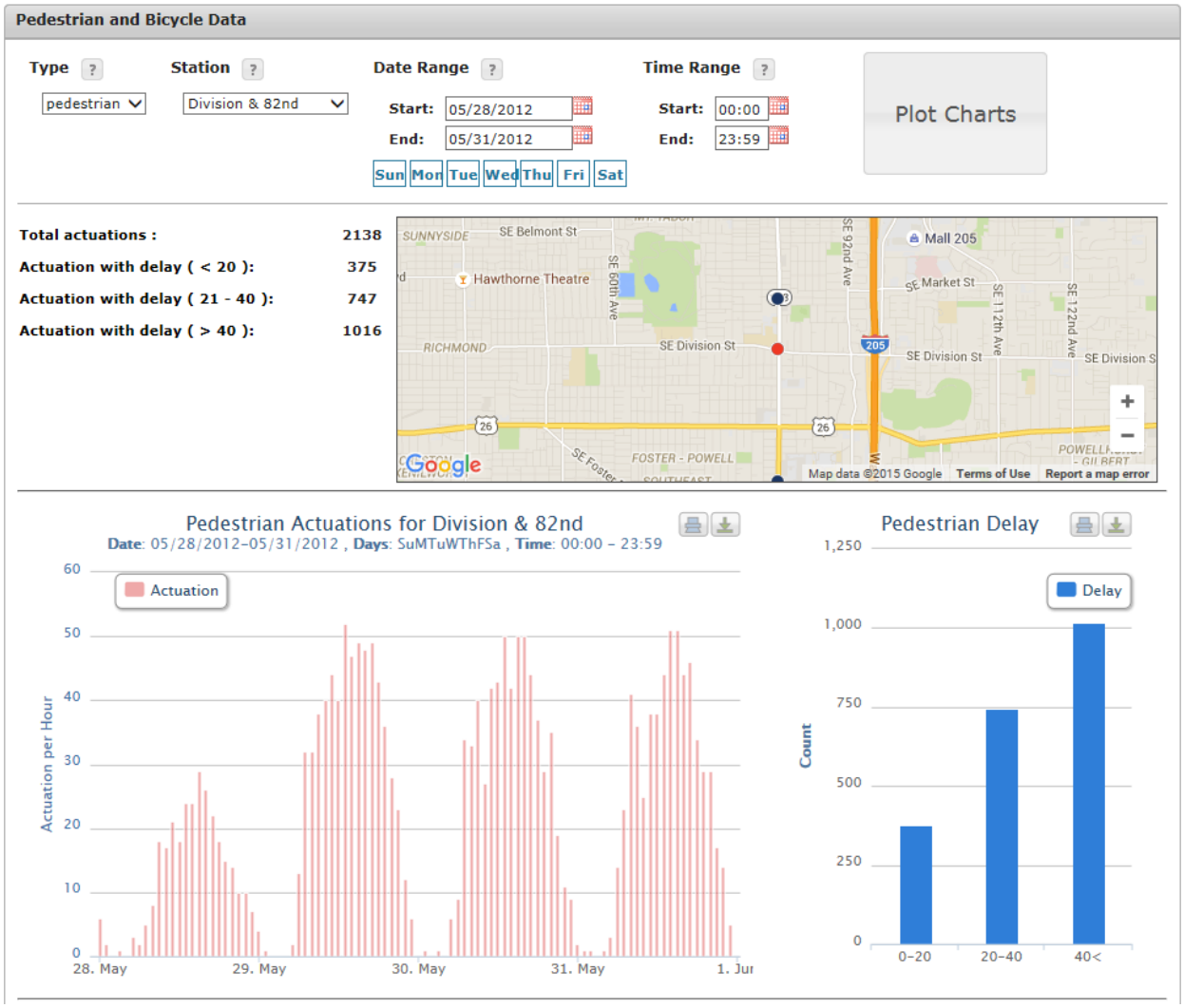
Source: PORTAL (2015)

Exhibit 11. Example PORTAL daily highway summary



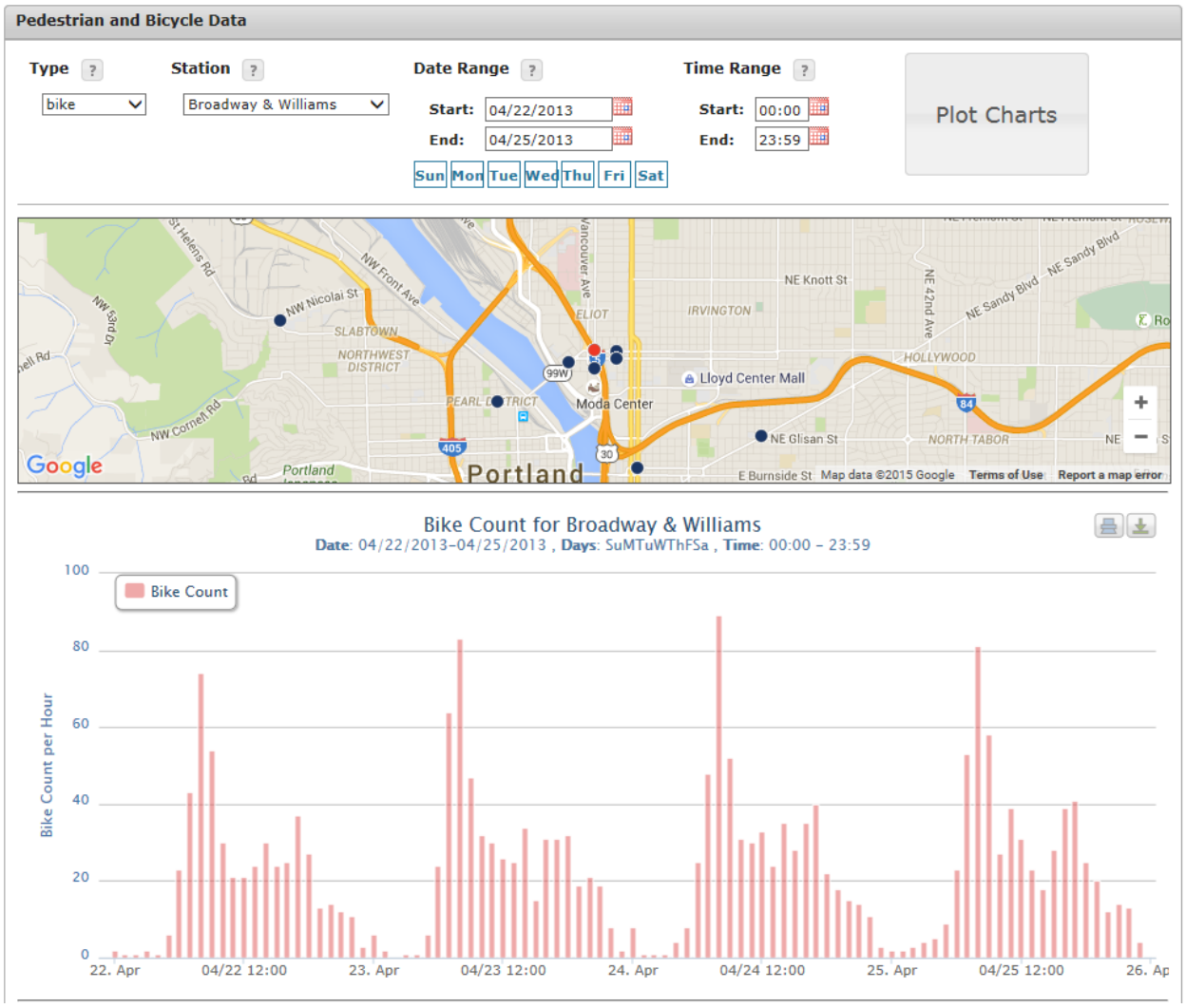
Source: PORTAL (2015)

Exhibit 12. Example pedestrian data search from demonstration PORTAL website



Source: PORTAL Demo Site (2015)

Exhibit 13. Example bicycle data search from demonstration PORTAL website



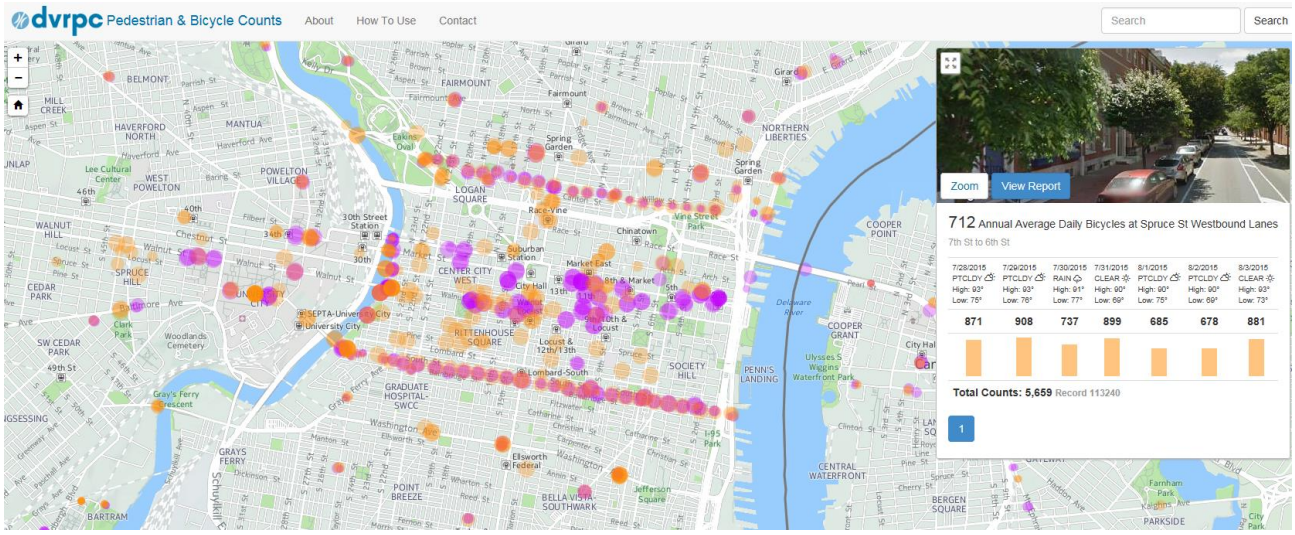
Source: PORTAL Demo Site (2015)

Delaware Valley Regional Planning Commission

The Delaware Valley Regional Planning Commission (DVRPC) has a pedestrian and bicyclist count program set up to collect continuous counts at 12 locations along Circuit Trails in the region. Exhibit 12 shows how the data is displayed online as of October 2015. Anyone interested is able to access the data easily online and view a summary or the full 24-hour counts at specific locations.

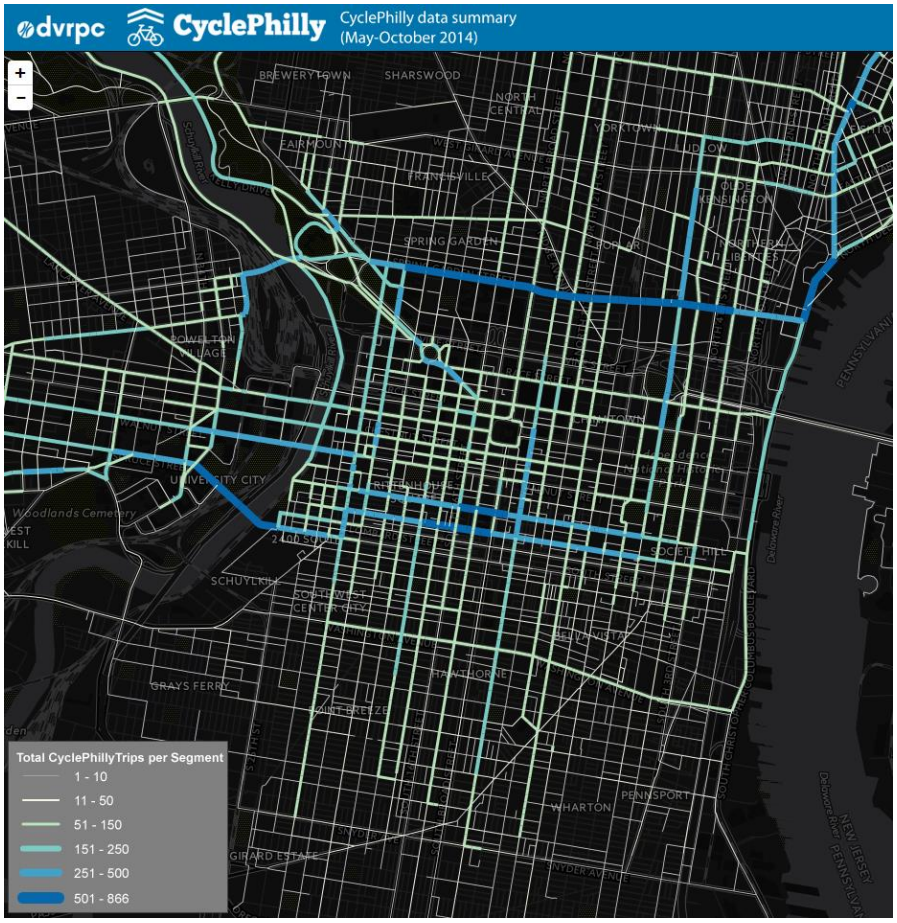
The DVRPC has also partnered with Code for Philly to launch an app called CyclePhilly where bicyclists can track their own trips to help generate data. Exhibit 13 shows how the data is displayed online as of October 2015.

Exhibit 14. Pedestrian and bicyclist count database display online



Source: The Delaware Valley Regional Planning Commission (2015)

Exhibit 15. CyclePhilly database display online



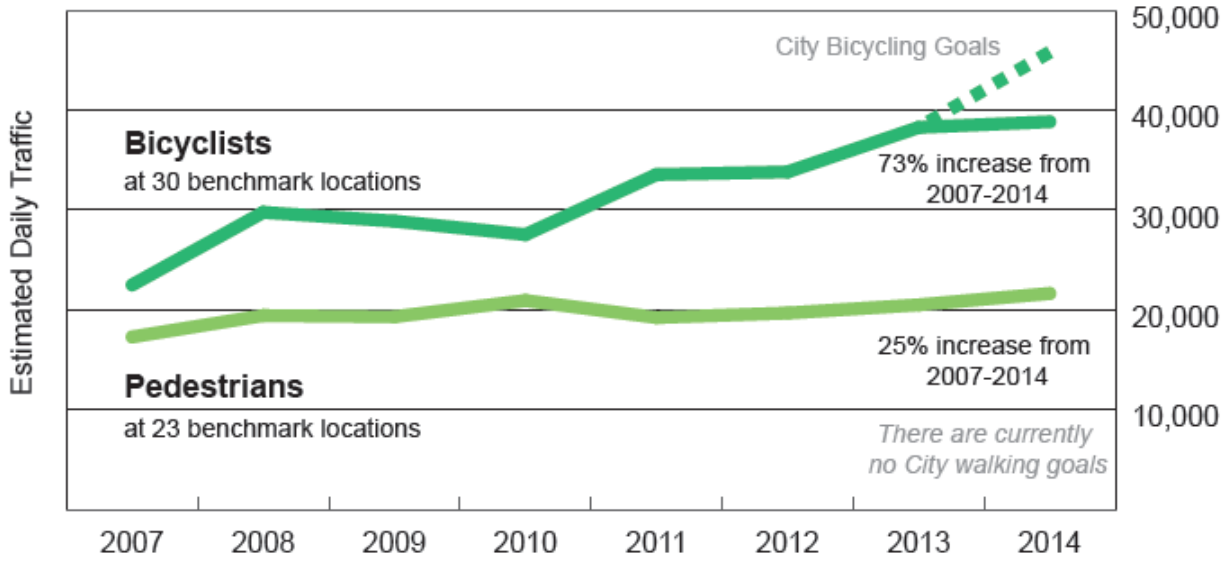
Source: The Delaware Valley Regional Planning Commission (2015)

Minneapolis Public Works Department

The Minneapolis Public Works Department has established an annual report to express current bicyclist and pedestrian volume counts and volume trends since 2007 throughout Minneapolis. The program uses trained volunteers to conduct counts during mid-September weekday p.m. peak hours using a standardized form and methodology. Traffic for a 24-hour period can then be estimated from the counts using a simple extrapolation factor. Over 300 locations are counted every three to four years. Additionally, 30 bicyclist benchmark locations and 23 pedestrian benchmark locations are counted every year to determine annual changes in non-motorized traffic.

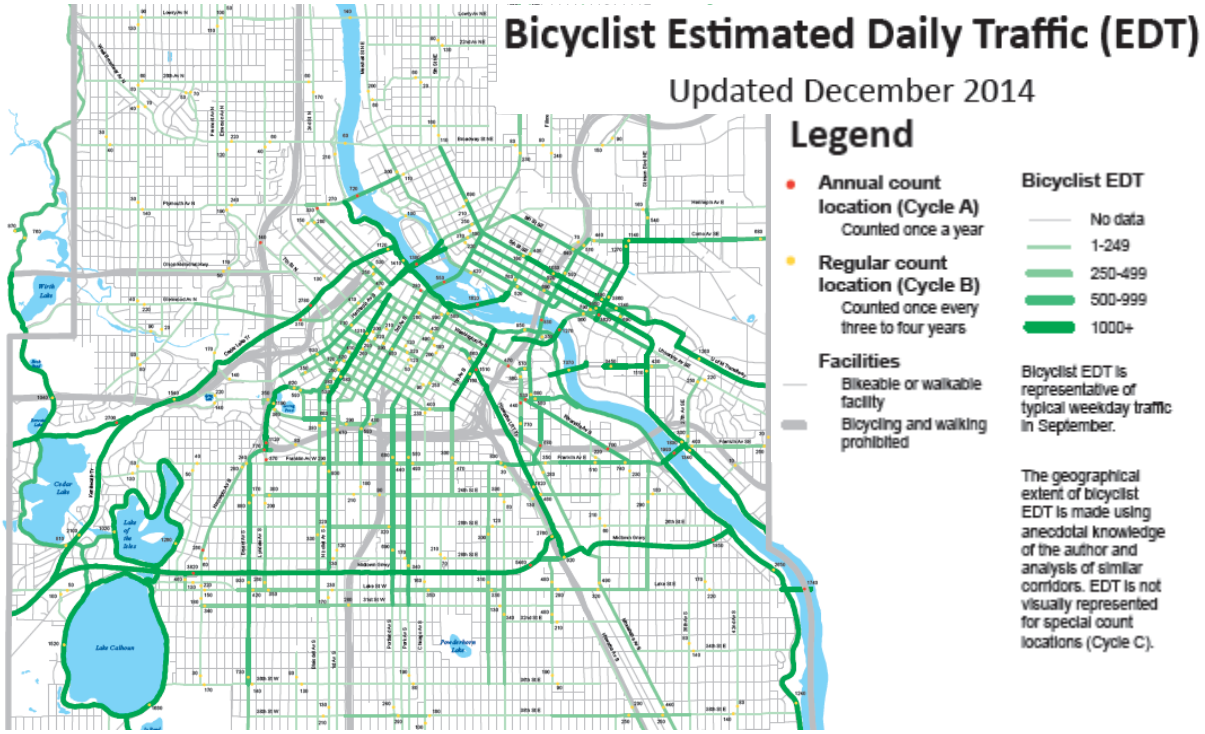
In addition to conducting annual counts, the Minneapolis Public Works Department expresses the results of the counts and trend analysis in an annual count report and bicycle traffic map, which are available on the department website. The annual bicyclist and pedestrian count report includes a summary of the count program, methodology, and the current year's volumes. The report also summarizes the trends seen in bicyclist and pedestrian activity before showing all the data and estimated daily traffic totals for all count locations since the beginning of the program. Exhibit 14 shows an example graphical representation of the trends seen at the benchmark locations for both bicyclists and pedestrians. Exhibit 15 shows how the Minneapolis Public Works Department expresses the bicyclist estimated daily traffic in map form. The roadways with higher bicyclist activity have wider line widths than those with lower bicycle volumes or no data, information that can be used to inform facility improvement locations or to prioritize projects.

Exhibit 16. Change in walking and bicycling activity at Minneapolis count sites, 2007–2014



Source: Minneapolis Public Works Department (2014)

Exhibit 17. Annual report pedestrian and bicyclist count database display



Source: Minneapolis Public Works Department (2014)

CONCLUSION

This document is intended to provide best practices in developing and maintaining a multimodal data collection program for the City of Bend. Recent national research and case studies help illustrate applications for count data; means of collecting, managing, and sharing data; and guidance on developing a count program. This memorandum will be reviewed alongside technical memorandum #1 to help inform Task 3 of the Multimodal Traffic Count Program (Implement the Count Program).

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Technical Memorandum #5.3:
Count Program Development

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Technical Memorandum #5.3: Count Program Development

Date: May 31, 2016 Project #: 17453.005

To: Jovi Anderson, Robin Lewis, Nick Arnis; City of Bend

From: Ashleigh Griffin, Kelly Laustsen
Project: Bend Transportation Planning Strategy – Task 5: Multimodal Traffic Count Program
Subject: Technical Memorandum #5.3: Count Program Development

This memo provides recommendations for the City of Bend's count program. It provides a summary of the following:

- The general purpose(s) of the data collection program;
- Data collection resources available to the City, including volunteer time, staff time, and funding;
- Recommended counting program, including locations, schedules, and counting methods; and
- Next steps in the count program development.

COUNT PROGRAM PURPOSE

The purpose of the City's count program was developed based on a review of current practices within the City, County, BPRD and ODOT and discussions with the City and project Technical Advisory Committee (TAC). The following sub-sections document the goals of the count program, intended data uses, and considerations for the program.

Count Program Goals

The City of Bend has developed the following goals for the development of the new count program:

- The count program should be easy to implement with minimal staff time required for maintenance or data manipulation. Data should be accessible without a field visit.
- The data should provide mode split information.
- Locations for data collection should be selected to allow for corridor trend analysis as well as regional analysis.

- Locations for data collection should supplement locations where ODOT, Deschutes County, and BPRD already collect regular data.
- Locations for data collection should be developed systematically rather than randomly in response to requests.
- The storage system for the counts should allow for incorporating data from other agencies as well as other projects such as Traffic Impact Analyses.
- The storage program should provide some flexibility to allow for future changes to incorporate new data, such as demographics.

Data Uses

In order to meet the goals above and ensure that meaningful data is collected through the count program, a list of potential uses of the data was developed. For the count program to be successful long-term, the data collected needs to be actively used and respond to high-priority needs. The intent is not to collect data randomly or at locations that seem to be "important," but to be systematic in collecting data that will serve a clear purpose. The following data uses articulate existing data needs or activities the City intends to pursue in the future with the count program data.

- Monitor use and trends
    - Understand trends in the transportation system (coverage counts)
    - Understand mode split on key corridors
    - Understand changes in mode split on key corridors
    - Understand the number of people walking and biking
    - Understand the number of transit riders
- Measure project success
    - Understand traffic changes before and after project implementation (including roadway projects as well as pedestrian/bike projects) – "before" data may also be used for grant applications.
- Plan for the future
    - Understand where transportation issues exist today (congestion, etc.) and how the system is operating to:
        - Be able to require development to complete appropriate mitigation
        - Appropriately plan for the future of the transportation network
- Prioritize maintenance activities and operations
    - Understand which areas experience the heaviest use (across all modes) to appropriately prioritize maintenance activities
    - Understand the number of users at various times and seasons to appropriately time signals to maximize operations performance

- Improve safety analysis
    - Use volume data in addition to crash data to understand exposure and where key issues are located

Other Considerations for Location Selection

To further inform the selection of count locations, the following were reviewed:

- Locations of counts currently done by other agencies (ODOT, BPRD) and identification of locations the City would like other agencies to count in the future.
- Locations where volunteers have historically collected counts.
- Bridges which provide key locations for capturing travel patterns across the river.
- Underpasses which provide key locations for capturing travel patterns across a corridor.
- The City's defined opportunity areas which were developed by the Urban Growth Boundary (UGB) Technical Advisory Committees.
- Bike boulevard corridors and enhanced crossings.
- The location of parks and schools, which serve as attractors for pedestrians and cyclists.
- Locations where counts are regularly collected for updating the City's travel demand model.
- Committed, build and illustrative roadway improvements.

The maps in *Attachment A* illustrate the data reviewed.

RESOURCES

In order to plan a count program that efficiently uses available resources, it was important to first understand the resources available to the City. Based on discussions with the City, the following resources are currently available or expected to be available in the future:

- **Staff Time**: limited staff time is available for implementing or maintaining the count program. Staff are available to review and download the data collected. In addition, the City has a new GIS specialist available for organizing the data storage and sharing system.
- **Volunteers**: the City currently utilizes volunteers to collect bicycle and pedestrian counts throughout the year. The program requires staff time to organize volunteers and record the data manually collected by volunteers. The City has had mixed success recruiting volunteers and could use a system that is more sustainable.
- **Funds**: there is approximately $15,000 available in this project's contract for collecting data. In addition, the City has $70,000 available in the IT budget, which is available for purchasing counters during the 2015-2016 fiscal year. The City intends to set aside approximately $50,000/year in future years to maintain the count program, which may be split among purchasing equipment and conducting counts.

- **Additional Support**: the City does not have support available for installing permanent counters, but it does have staff that can manage the installation of the counters.

COUNTING PROGRAM

Based on the count program purpose and available resources, we worked with the City in an iterative process to define the count locations, types, prioritization, and schedule.

Count Locations, Types and Prioritization

The count program was broken up into vehicle count locations and multimodal count locations to more easily select and view high priority locations for data.

Vehicle Counts

At the vehicle count locations, twenty-four hour tube count data will be collected. Tube count data was selected over turning movement counts in order to more cost effectively get a longer span of data collection and collect vehicle speed and classification data. Vehicle count locations were prioritized into the following categories:

- **High priority** locations where data will be collected annually (these locations include bridges, high volume roadways, and a representation of the opportunity areas)
- **Lower priority** locations where data will be collected every two years (half of these locations will be counted one year and the other half the next year)
- **Lower priority** locations where **base counts** are needed (at these locations, data will be collected during year one of the data collection program to provide a base count and then during alternating years in the future)
- **ODOT** locations (ODOT collects data at these locations which is available to the City).

A map of the vehicle count locations and corresponding table is provided in *Attachment B.*

Multimodal Counts

At the multimodal locations, a variety of options are available for collecting bicycle, pedestrian, and/or vehicle data, including:

- **BPRD** currently collects counts at a variety of locations using portable TraffX counters that are installed long-term on select trails around the community and sometimes moved to new locations as needed. Additional locations were identified where the City would also like BPRD to collect data as future resources allow.
- **ODOT** currently collects counts on its facilities using video cameras. The locations are primarily based on requests from the City.

- **Volunteers** currently collect counts at several times throughout the year at identified locations. These counts include bicycle turning movement counts at intersections and bicycle and pedestrian screenline counts at roadway segments.
- **Short-term counts** can be collected via video by a data collection firm. These counts can provide whatever data is desired, from intersection turning movement counts to screenline counts.
- **Long-term counts** can be collected via a variety of technologies, including roadway tubes, infrared sensors, and inductive loops. These technologies can be installed permanently or be designed to be portable for shorter installations.

Multimodal count locations were identified to utilize all of the above options. Long-term count locations were selected primarily at bridges or key undercrossings and intended to provide mode split and information about seasonal trends and annual ridership. The long-term count locations were prioritized to identify locations to install in the near-term (summer 2016) and in the future as funding is available. Short-term count locations were selected to capture information about opportunity areas, existing bicycle routes, key crossings, and trails. The short-term count locations are intended to be counted by a data collection firm in the spring, with volunteers counting the highest priority locations again in the fall.

A map of the multimodal count locations and corresponding table is provided in *Attachment C.*

Count Schedule

The schedule for the count program is shown in Table 1. The schedule is intended to be followed each year with changes made as needed.

Table 1. Count Program Schedule

	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Reassess count locations, types and priorities based on past report												
Collect spring counts at annual locations												
Collect summer counts at select locations												
Collect fall bicycle and pedestrian counts with volunteers plus any annual locations not collected in spring												
Produce annual report summarizing data collection from past year (spring, summer and fall counts, plus permanent counts)												

Notes:

- Update data collection firm three months in advance of data collection to schedule counts.
- Check construction schedule two weeks in advance of data collection to assess any conflicts with count locations.

NEXT STEPS

The count program outlined in this memorandum will be implemented with a first round of spring counts in May 2016. The first annual report will be produced in the winter of 2016, which will provide an opportunity to assess the success of the count program and make any needed adjustment to count locations, types or priorities.

ATTACHMENTS

A: Data Reviewed

B: Vehicle data collection locations (map and table)

C: Multimodal data collection locations (map and table)

Attachment A
Data Reviewed

BPRD Count Location

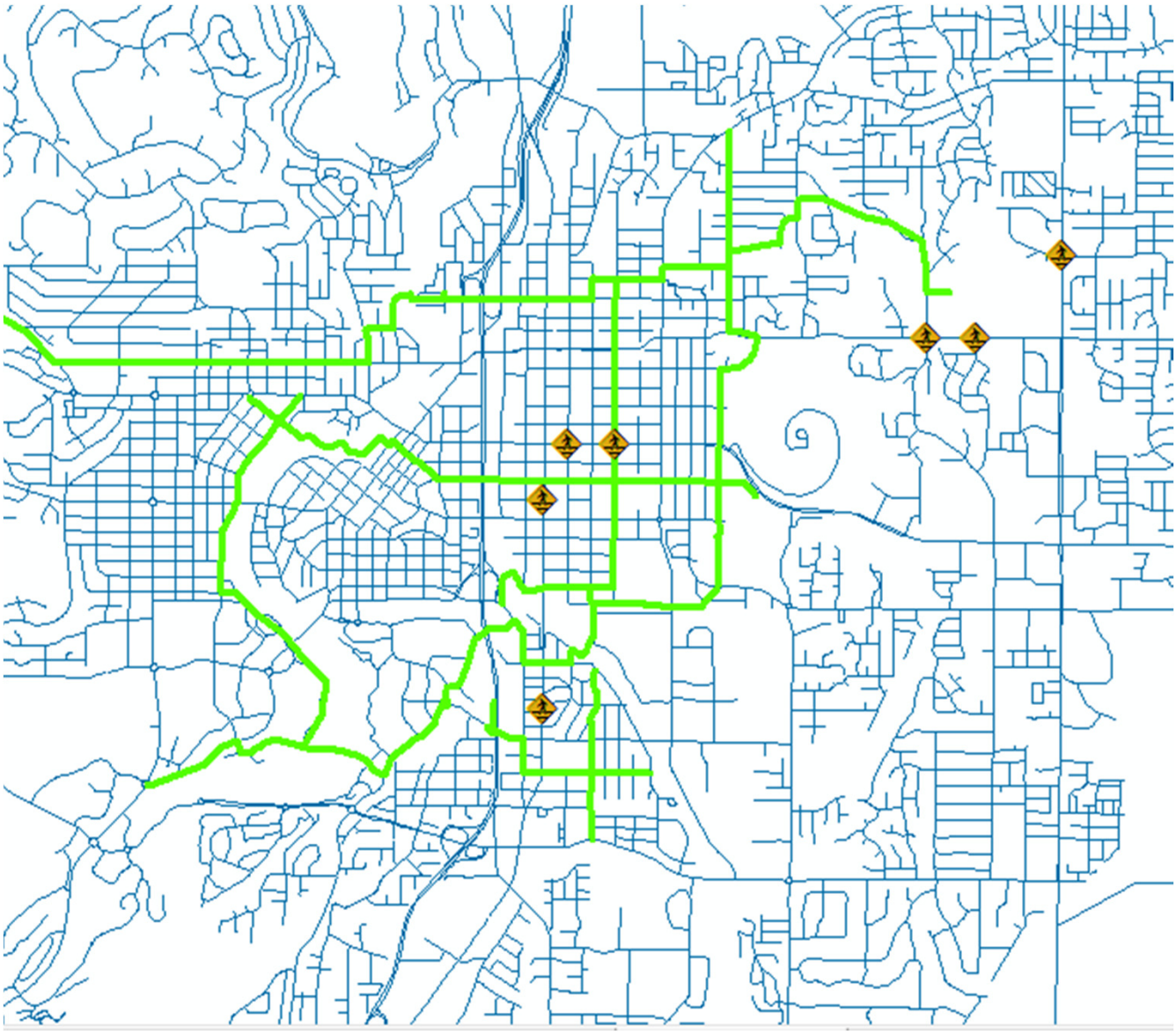
ODOT Count Location

Vounteer Count Location

Bridge Locations

Redevelopment and Infill Potential

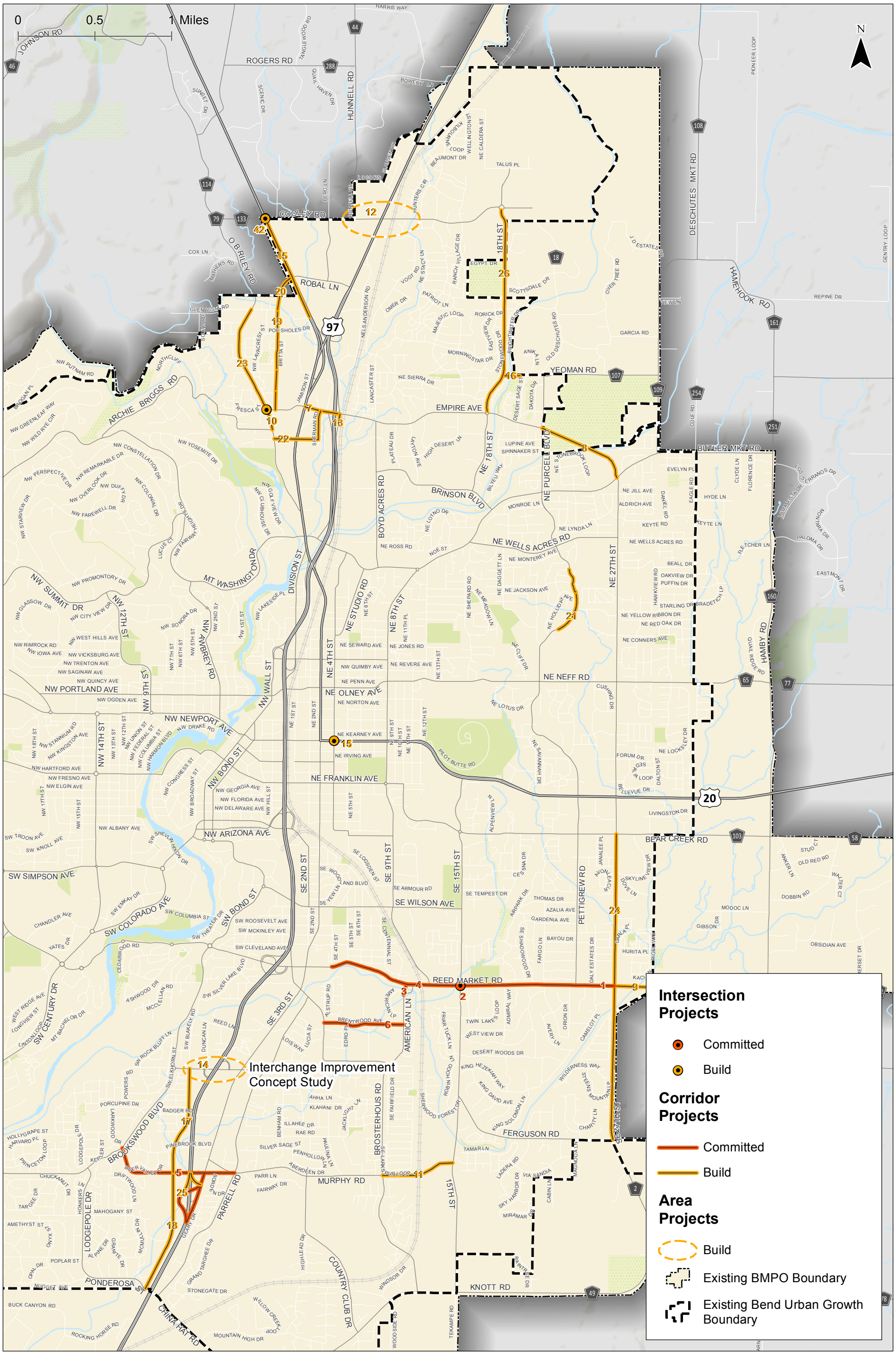
Bike Boulevard Corridors and Enhanced Crossings



Model Count Locations

- NonStateCounts
- LocalCounts
- HwyCounts

Elementary/Middle School
High School
College/University
Park



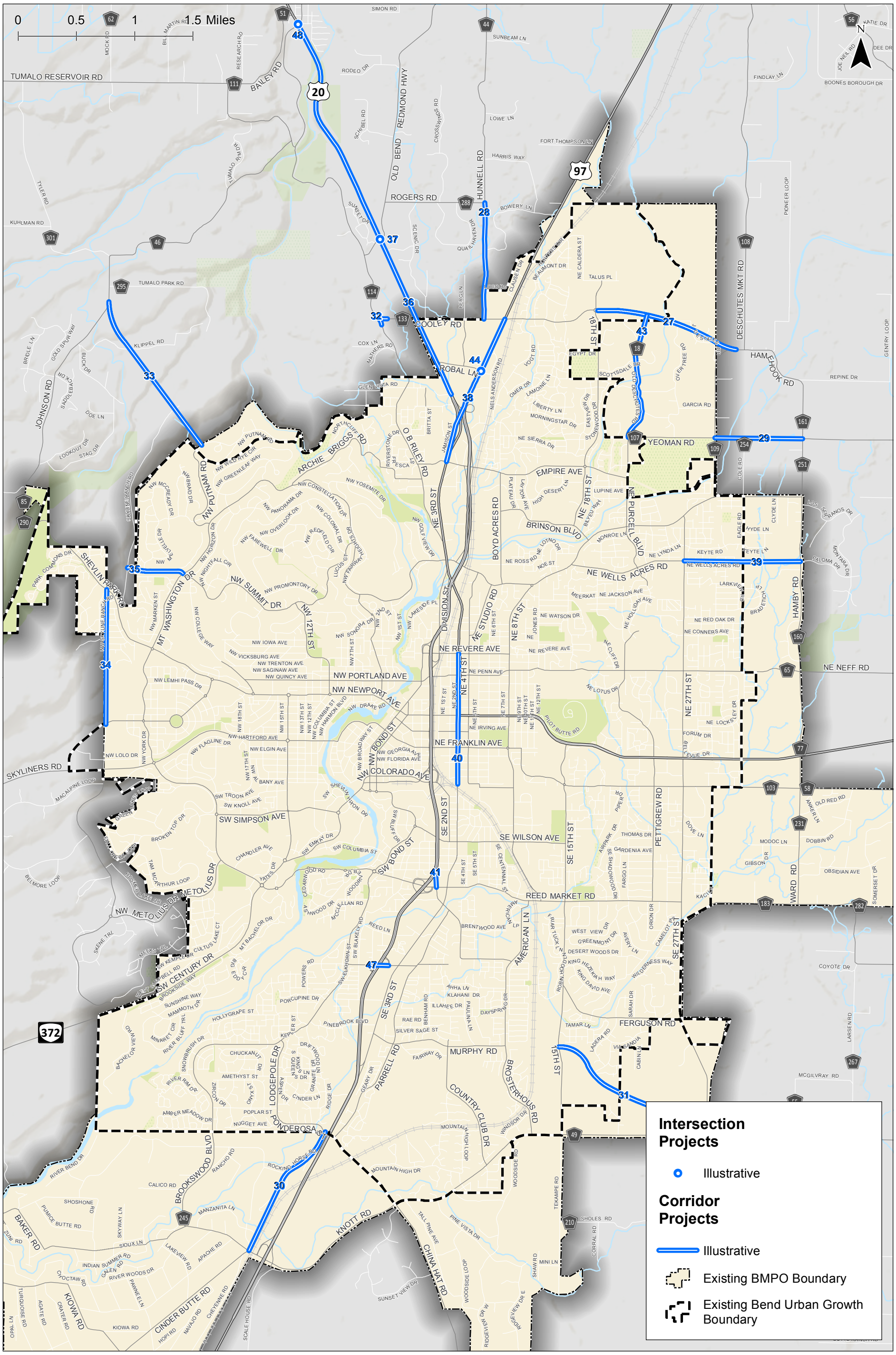
Committed and Build Roadway Improvements
Bend, Oregon

Figure **6-3**

BEND MPO
Metropolitan Planning Organization

K:\H_Portland\proj\le\11176 - Bend MPO MTP Update\gis\6-3 Committed and Build Roadway Improvements_final.mxd - agriffin - 9:47 AM 10/2/2014

Coordinate System: NAD 1983 HARN StatePlane Oregon South FIPS 3602 Feet Intl



Intersection Projects

- Illustrative

Corridor Projects

- Illustrative
- Existing BMPO Boundary
- Existing Bend Urban Growth Boundary

BEND MPO
Metropolitan Planning Organization

Illustrative Roadway Improvements
Bend, Oregon

Figure **6-4**

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Coordinate System: NAD 1983 HARN StatePlane Oregon South FIPS 3602 Feet Intl

Attachment B

Vehicle Data Collection Locations

Vehicle Count Locations

- High Priority (47)
- Med/Low Priority, Base Count Needed (9)
- Med/Low Priority (63)
- ODOT (21)

Vehicle Count Locations

ID	RoadName	Location	Priority	Base Count	Permanent Counter?	Count Duration	Bridge/ Undercrossing
1	Mt. Washington Drive	north of Simpson Avenue	High	no		24 hour tube count	
2	Simpson Avenue	east of Mt. Washington Drive	High	no		24 hour tube count	
3	SW Century Drive	south of Reed Market Road	High	no		24 hour tube count	
4	Mt. Washington Drive	west of Century Drive	High	no		24 hour tube count	
5	SW Century Drive	north of Reed Market Road	High	no		24 hour tube count	
6	SW Century Drive	south of Simpson Avenue	High	no		24 hour tube count	
7	NW 14th Street	north of Simpson Avenue	High	no		24 hour tube count	
8	Simpson Avenue	west of SW Colorado Avenue	High	no		24 hour tube count	
9	Colorado Avenue	Deschutes river bridge	High	no	Near-term permanent location	24 hour tube count	Bridge
10	Columbia Street	Deschutes river bridge	High	no	Future permanent location	24 hour tube count	Bridge
11	Skyliners Road	west of NW 14th Street	High	no		24 hour tube count	
12	Galveston Avenue	Deschutes River bridge	High	no	Near-term permanent location	24 hour tube count	Bridge
13	Newport Avenue	west of NW 14th Street	High	no		24 hour tube count	
14	NW 14th Street	south of NW Newport Avenue	High	no		24 hour tube count	
15	Newport Avenue	Deschutes River bridge	High	no	Future permanent location	24 hour tube count	Bridge
16	Portland Avenue	Deschutes River bridge	High	no	Future permanent location	24 hour tube count	Bridge
17	Wall Street	south of NE Olney Avenue	High	no		24 hour tube count	
18	Wall Street	north of NW Colorado Avenue	High	no		24 hour tube count	
19	Bond Street	north of NW Colorado Avenue	High	no		24 hour tube count	
20	Colorado Avenue	east of NW Bond Street	High	no		24 hour tube count	
21	Arizona Avenue	east of NW Bond Street	High	no		24 hour tube count	
22	Bond Street	east of NW Bond Street	High	no		24 hour tube count	
23	Wilson Avenue	east of Bond Street	High	no		24 hour tube count	Bridge
24	Bond Street	south of Wilson Avenue	High	no		24 hour tube count	
25	Bond Street	north of Reed Market Road	High	no		24 hour tube count	
26	3rd Street	rail undercrossing	High	no		24 hour tube count	Rail undercrossing
27	Franklin Avenue	Parkway undercrossing	High	no	Near-term permanent location	24 hour tube count	undercrossing
28	Franklin Avenue	east of 3rd Street	High	no		24 hour tube count	
29	Greenwood Avenue	Parkway undercrossing	High	no	Near-term permanent location	24 hour tube count	undercrossing
30	Greenwood Avenue	east of 3rd Street	High	no		24 hour tube count	
31	3rd Street	north of Greenwood Avenue	High	no		24 hour tube count	
32	9th Street	north of SE Glenwood Dr	High	no		24 hour tube count	
33	Olney Avenue	east of 3rd Street	High	no		24 hour tube count	
34	8th Street	south of Olney Avenue	High	no		24 hour tube count	
35	Purcell Boulevard	north of Neff Road	High	no		24 hour tube count	
36	Purcell Boulevard	south of Neff Road	High	no		24 hour tube count	
37	Neff Road	west of 27th Street	High	no		24 hour tube count	
38	27th Street	north of Neff Road	High	no		24 hour tube count	
39	Neff Road	east of 27th Street	High	no		24 hour tube count	
40	27th Street	south of Neff Road	High	no		24 hour tube count	
41	Revere Avenue	at-grade rail crossing	High	no		24 hour tube count	
42	Reed Market Road	Deschutes River bridge	High	no	Future permanent location	24 hour tube count	Bridge
43	Brookswood Boulevard	north of Murphy RAB	High	no		24 hour tube count	

Vehicle Count Locations

ID	RoadName	Location	Priority	Base Count	Permanent Counter?	Count Duration	Bridge/ Undercrossing
44	Brookswood Boulevard	west of Murphy RAB	High	no		24 hour tube count	
45	Reed Market Rd	West of SE 3rd St	High	no		24 hour tube count	
46	Reed Market Rd	East of SE 3rd St	High	no		24 hour tube count	
47	SE 3rd St	N of Reed Market Rd	High	no		24 hour tube count	
48	Cooley Road	east of Hunnell Road	Med/Low	no		24 hour tube count	
49	Hunnell Road	south of Cooley Road	Med/Low	no		24 hour tube count	
50	Cooley Road	east of OB Riley Road	Med/Low	no		24 hour tube count	
51	OB Riley Road	south of Cooley Road	Med/Low	no		24 hour tube count	
52	Empire Avenue	east of US 97 NB ramps	Med/Low	yes		24 hour tube count	
53	18th Street	south of Empire Avenue	Med/Low	yes		24 hour tube count	
54	Empire Avenue	east of 18th Street	Med/Low	yes		24 hour tube count	Canal Bridge on Empire
55	Mt. Washington Drive	Deschutes River (west of 3rd Street)	Med/Low	no		24 hour tube count	Bridge
56	Division Street	canal bridge (south of 3rd Street)	Med/Low	no		24 hour tube count	Bridge
57	Regency Street	east of Mt. Washington Drive	Med/Low	no		24 hour tube count	
58	Shevlin Park Road	west of Mt. Washington Drive	Med/Low	no		24 hour tube count	
59	Mt. Washington Drive	north of Shevlin Park Road	Med/Low	no		24 hour tube count	
60	Shevlin Park Road	east of Mt. Washington Drive	Med/Low	no		24 hour tube count	
61	Mt. Washington Drive	north of Skyliners Road	Med/Low	no		24 hour tube count	
62	Skyliners Road	west of Mt. Washington Drive	Med/Low	no		24 hour tube count	
63	Columbia Street	north of Simpson Avenue	Med/Low	no		24 hour tube count	
64	Columbia Street	south of Simpson Avenue	Med/Low	no		24 hour tube count	
65	College Way	south of NW Portland Avenue	Med/Low	no		24 hour tube count	
66	Portland Avenue	east of NW College Way	Med/Low	no		24 hour tube count	
67	Reed Market Road	east of Bond Street	Med/Low	no		24 hour tube count	
68	Brookswood Boulevard	south of Reed Market Road	Med/Low	no		24 hour tube count	
69	3rd Street	north of Murphy Road	Med/Low	yes		24 hour tube count	
70	Murphy Road	west of 3rd Street	Med/Low	yes		24 hour tube count	Bridge
71	Murphy Road	east of 3rd Street	Med/Low	yes		24 hour tube count	
72	American Lane	south of Reed Market Road	Med/Low	no		24 hour tube count	Bridge Count
73	Reed Market Road	west of SE 27th Street	Med/Low	no		24 hour tube count	
74	SE 27th Street	south of Reed Market Road	Med/Low	no		24 hour tube count	Canal Bridge South of this count
75	SE 27th Street	north of Reed Market Road	Med/Low	no		24 hour tube count	
76	Olney Avenue	west of 3rd Street	Med/Low	no		24 hour tube count	
77	Highway 20	west of Purcell Boulevard	Med/Low	no		24 hour tube count	
78	Highway 20	east of Purcell Boulevard	Med/Low	no		24 hour tube count	
79	Revere Avenue	east of 3rd Street	Med/Low	no		24 hour tube count	
80	18th Street	south of Cooley Road	Med/Low	yes		24 hour tube count	
81	Cooley Road	west of 18th Street	Med/Low	yes		24 hour tube count	
82	Cooley Road	east of US 97 at rail crossing	Med/Low	no		24 hour tube count	Rail
83	Archie Briggs Road	Deschutes River	Med/Low	no		24 hour tube count	Bridge
84	OB Riley Road	south of Empire Avenue	Med/Low	no		24 hour tube count	
85	Empire Avenue	west of US 20	Med/Low	no		24 hour tube count	
86	Empire Avenue	east of US 20	Med/Low	no		24 hour tube count	

Vehicle Count Locations

ID	RoadName	Location	Priority	Base Count	Permanent Counter?	Count Duration	Bridge/ Undercrossing
87	Boyd Acres Road	south of Brinson Boulevard	Med/Low	no		24 hour tube count	
88	Butler Market Road	west of NE 27th street	Med/Low	no		24 hour tube count	
89	NE 27th Street	south of Butler Market Road	Med/Low	no		24 hour tube count	
90	Purcell Boulevard	north of Butler Market Road	Med/Low	no		24 hour tube count	Canal Bridge on Purcell North of Count
91	Butler Market Road	west of NE 8th Street	Med/Low	no		24 hour tube count	
92	Butler Market Road	north of NE 8th Street	Med/Low	no		24 hour tube count	
93	Crossing Drive	west of Mt. Washington Drive	Med/Low	no		24 hour tube count	
94	Chandler Avenue	west of Century Drive	Med/Low	no		24 hour tube count	
95	SW Shevlin Hixon Drive	east of SW Colorado Avenue	Med/Low	no		24 hour tube count	
96	Powers Road	east of Brookswood Boulevard	Med/Low	no		24 hour tube count	
97	Brookswood Boulevard	north of Amber Meadow Drive	Med/Low	no		24 hour tube count	
98	China Hat Road	NW of Knott Road	Med/Low	no		24 hour tube count	
99	Knott Road	NE of China Hat Road	Med/Low	no		24 hour tube count	
100	Country Club Drive	at-grade rail crossing	Med/Low	no		24 hour tube count	Rail Crossing
101	Brosterhous Road	rail undercrossing	Med/Low	no		24 hour tube count	Rail Undercrossing
102	15th Street	north of Knott Road	Med/Low	no		24 hour tube count	
103	Rickard Road	east of SE 27th Street	Med/Low	no		24 hour tube count	
104	Murphy Road	west of Brosterhous Road	Med/Low	no		24 hour tube count	
105	Powers Road	west of 3rd Street	Med/Low	no		24 hour tube count	Parkway crossing
106	Powers Road	at Parrell Rd	Med/Low	no		24 hour tube count	
107	Chase Road	SW of Brosterhous Road when new connection open	Med/Low	no		24 hour tube count	
108	Brosterhous Road	north of new Chase Road connection	Med/Low	yes		24 hour tube count	
109	Brosterhous Road	east of new Chase Road connection	Med/Low	no		24 hour tube count	
110	Brosterhous Road	east of SE 3rd Street	Med/Low	no		24 hour tube count	
111	Wilson Avenue	at-grade rail crossing/west of 9th Street	Med/Low	no		24 hour tube count	At-grade rail crossing
112	SE 2nd Street	north of Wilson Avenue	Med/Low	no		24 hour tube count	
113	4th Street	north of Greenwood Avenue	Med/Low	no		24 hour tube count	
114	4th Street	south of Greenwood Avenue	Med/Low	no		24 hour tube count	
115	Bear Creek Road	east of 27th Street	Med/Low	no		24 hour tube count	Canal Bridge East of Count Location
116	Benham	Benham Road At canal between Chase and Rae	Med/Low	no		24 hour tube count	Canal Bridge
117	Pettigrew	canal bridge on Pettigrew between Reed Market and Bear Creek	Med/Low	no		24 hour tube count	Canal Bridge
118	Brinson	Near canal bridge on Brinson west of Butler Market Signal	Med/Low	no		24 hour tube count	Canal Bridges on Brinson
119	NE 15th Street	north of Bear Creek Rd	Med/Low	no		24 hour tube count	
120	US 97	north of Cooley Road	ODOT	no			
121	US 97	south of Cooley Road	ODOT	no			
122	US 20	north of Cooley Road	ODOT	no			
123	US 20	south of Cooley Road	ODOT	no			
124	US 20	north of Empire Avenue	ODOT	no			
125	US 20	south of Empire Avenue	ODOT	no			
126	US 97/Empire Avenue SB On-Ramps	south of Empire Avenue	ODOT	no			
127	US 97/Empire Avenue NB On-Ramps	north of Empire Avenue	ODOT	no			
128	US 97/Empire Avenue NB Off-Ramps	south of Empire Avenue	ODOT	no			
129	SW Century Drive	west of City boundary (west of Skyline Ranch Road)	ODOT	no			

Vehicle Count Locations

ID	RoadName	Location	Priority	Base Count	Permanent Counter?	Count Duration	Bridge/ Undercrossing
130	US 97/Powers NB Ramps	NB ramps	ODOT	no			
131	US 97/Powers SB Ramps	SB Ramps	ODOT	no			
132	US 97/Reed Market Road	SB On Ramp	ODOT	no			
133	US 97/Reed Market Road	SB On/Off Ramp	ODOT	no			
134	US 97/Reed Market Road	NB Ramps	ODOT	no			
135	US 97/Colorado Avenue	SB Ramps	ODOT	no			
136	US 97/Colorado Avenue	NB Ramps	ODOT	no			
137	Highway 20	west of 27th Street	ODOT	no			
138	Highway 20	east of 27th Street	ODOT	no			
139	US 97/Revere Avenue	SB Ramps	ODOT	no			
140	US 97/Revere Avenue	NB Ramps	ODOT	no			

Attachment C

Multimodal Data Collection Locations

Multimodal Count Locations

Pedestrian and Bicycle Short-Term Count

- Quality Counts (High Priority, 19)
- Quality Counts (Med/Low Priority, 14)
- ODOT (7)
- Volunteer (14)
- Existing BPRD Location (9)
- Proposed BPRD Location (5)

Permanent Count (vehicles, bicycles, and pedestrians)

- Near-Term Location
- Future Planned Location

Multimodal Count Locations

ID	RoadName	Location	Collection Type	Permanent Counter?	Count Type	CountDurat	Bridge/ Undercrossing
1	Revere Avenue	at-grade rail crossing	Quality Counts (high priority)		E/W bike/ped	2 hours	
2	Deschutes River Trail	Columbia Park Bridge	Quality Counts (high priority)	Future permanent location	Screenline bike/ped	2 hours	Bridge
3	Canal Trail	crossing at Purcell Boulevard	Quality Counts (high priority)		Screenline bike/ped	4 hours (7:30-9:30 am, 2:30-4:30 pm)	
4	Colorado Avenue	Deschutes River bridge	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	Bridge
5	Columbia Street	Deschutes River bridge	Quality Counts (high priority)	Future permanent location	Screenline bike/ped	2 hours	Bridge
6	Galveston Avenue	Deschutes River bridge	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	Bridge
7	Newport Avenue	Deschutes River bridge	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	Bridge
8	Portland Avenue	Deschutes River bridge	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	Bridge
9	Drake Park Footbridge	Deschutes River bridge	Quality Counts (high priority)	Future permanent location	Screenline bike/ped	2 hours	Bridge
10	Reed Market Road	Deschutes River bridge	Quality Counts (high priority)	Future permanent location	Screenline bike/ped	2 hours	Bridge
11	Franklin Avenue	Parkway undercrossing	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	undercrossing
12	Greenwood Avenue	Parkway undercrossing	Quality Counts (high priority)	Near-term permanent location	Screenline bike/ped	2 hours	undercrossing
13	SW Century Drive	SW Colorado Avenue	Quality Counts (high priority)		Intersection TMC	2 hours	
14	Industrial Way/Bond Street	intersection	Quality Counts (high priority)		Intersection TMC for bikes	2 hours	
15	Trail near Industrial and Crux	east side of Industrial Way	Quality Counts (high priority)		Screenline bike/ped	2 hours	
16	14th Street/Simpson	intersection	Quality Counts (high priority)		Intersection TMC for bikes	2 hours	
17	SE 15th Street	at Reed Market Road	Quality Counts (med/low priority)		Bike TMC and ped crosswalks	2 hours	
18	NE 15th Street	at Bear Creek Rd	Quality Counts (med/low priority)		Bike TMC and ped crosswalks	2 hours	
19	NE 8th St	at Franklin Ave	Quality Counts (med/low priority)		Bike TMC and ped crosswalks	2 hours	
20	Powers Road	at Parrell Rd	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	
21	SE 3rd Street	at Reed Market Rd	Quality Counts (med/low priority)		Bike TMC and ped crosswalks	2 hours	
22	Neff Road	Purcell Boulevard	Quality Counts (med/low priority)	Future permanent location (west leg)	Intersection TMC	4 hours (2-6 pm)	
23	Brosterhous Road	east of SE 3rd Street	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	
24	3rd Street	north of Powers Road	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	
25	9th Street	north of SE Glenwood Dr	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	
26	Powers Road	west of 3rd Street	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	Parkway crossing
27	Columbia Street	south of Commerce Street	Quality Counts (med/low priority)		Screenline bike/ped	2 hours	
28	NE 3rd Street	at Greenwood	ODOT				
29	NE 12th Street	at Greenwood ped crossing	ODOT		Screenline bike/ped		
30	3rd Street	At Mt. Washington Drive	ODOT		Intersection TMC for bikes		
31	3rd Street	At NE Underwood Ave	ODOT				
32	Reed Lane	RRFB at Bend Parkway	ODOT		Screenline bike/ped		
33	Badger Rd	RRFB at Bend Parkway	ODOT		E/W bike/ped		
34	3rd Street	At NE Seward Ave	ODOT		Intersection TMC	2 hours	
35	Newport Avenue	At NW Harmon Blvd	Volunteer		N/S & E/W bike/ped		
36	Trail	Bend Parkway Undercrossing	Volunteer		Screenline bike/ped	2 hours	
37	15th Street	At Galveston Avenue	Volunteer		N/S & E/W bike/ped	2 hours	
38	NE 45th Street	at Greenwood Ave	Volunteer		N/S & E/W bike/ped	2 hours	
39	NW 14th Street	At Milwaukee Avenue	Volunteer		N/S & E/W bike/ped	2 hours	
40	NE 27th Street	At NE Conners Drive/Avenue	Volunteer		N/S & E/W bike/ped	2 hours	
41	NE 27th Street	at NE Forum Dr	Volunteer		Screenline bike/ped	2 hours	
42	SE 3rd Street	At Pineboork Blvd	Volunteer		N/S bike/ped	2 hours	
43	SE 3rd Street	at SE Roosevelt Ave	Volunteer		E/W bike/ped	2 hours	
44	NE 6th Street	crossing at Greenwood Avenue	Volunteer		N/S bike/ped	2 hours	
45	Neff Road	E of Williamson Blvd at hospital	Volunteer		N/S & E/W bike/ped	2 hours	
46	Hartford Avenue	east of 14th Street	Volunteer		Screenline bike/ped	2 hours	
47	NE 3rd Street	Hawthorne Transit Station	Volunteer		E/W bike/ped	2 hours	

Multimodal Count Locations

ID	RoadName	Location	Collection Type	Permanent Counter?	Count Type	CountDurat	Bridge/ Undercrossing
48	Wilson Avenue	west of 5th Street	Volunteer		Screenline bike/ped	2 hours	
49	Colorado Ave bike/ped bridge	Deschutes River Crossing	BPRD (proposed)		Screenline bike/ped		
50	Riverbend Park bike/ped bridge	Deschutes River Crossing	BPRD (proposed)		Screenline bike/ped		
51	Colorado Avenue	Deschutes River trail undercrossing	BPRD (proposed)		Screenline bike/ped		undercrossing
52	Trail at Reed Market/Deschutes River Trail (west)	West side of Deschutes River	BPRD (proposed)		Screenline bike/ped		
53	Larkspur Trail, South	south area of trail	BPRD (proposed)		Screenline bike/ped		
54	Central Oregon Canal Trail	west of parkway	BPRD (existing)		Screenline bike/ped		undercrossing
55	Larkspur Trail/Hwy 20 Undercrossing	trail undercrossing	BPRD (existing)		Screenline bike/ped		
56	Deschutes River Trail, North	Deschutes River Trail	BPRD (existing)		Screenline bike/ped		
57	Tumalo Creek Trail, North	N of NW Shevlin Park Rd	BPRD (existing)		Screenline bike/ped		
58	Haul Road Trail	W of Mammoth Drive	BPRD (existing)		Screenline bike/ped		
59	West Bend Trail	North of Skyliners Rd	BPRD (existing)		Screenline bike/ped		
60	Tumalo Creek Trail, South	S of NW Shevlin Park Rd	BPRD (existing)		Screenline bike/ped		
61	Coyner Trail	south of NE Burnside Avenue	BPRD (existing)		Screenline bike/ped		
62	Trail at Reed Market/Deschutes River Trail (east)	East side Deschutes River	BPRD (existing)		Screenline bike/ped		