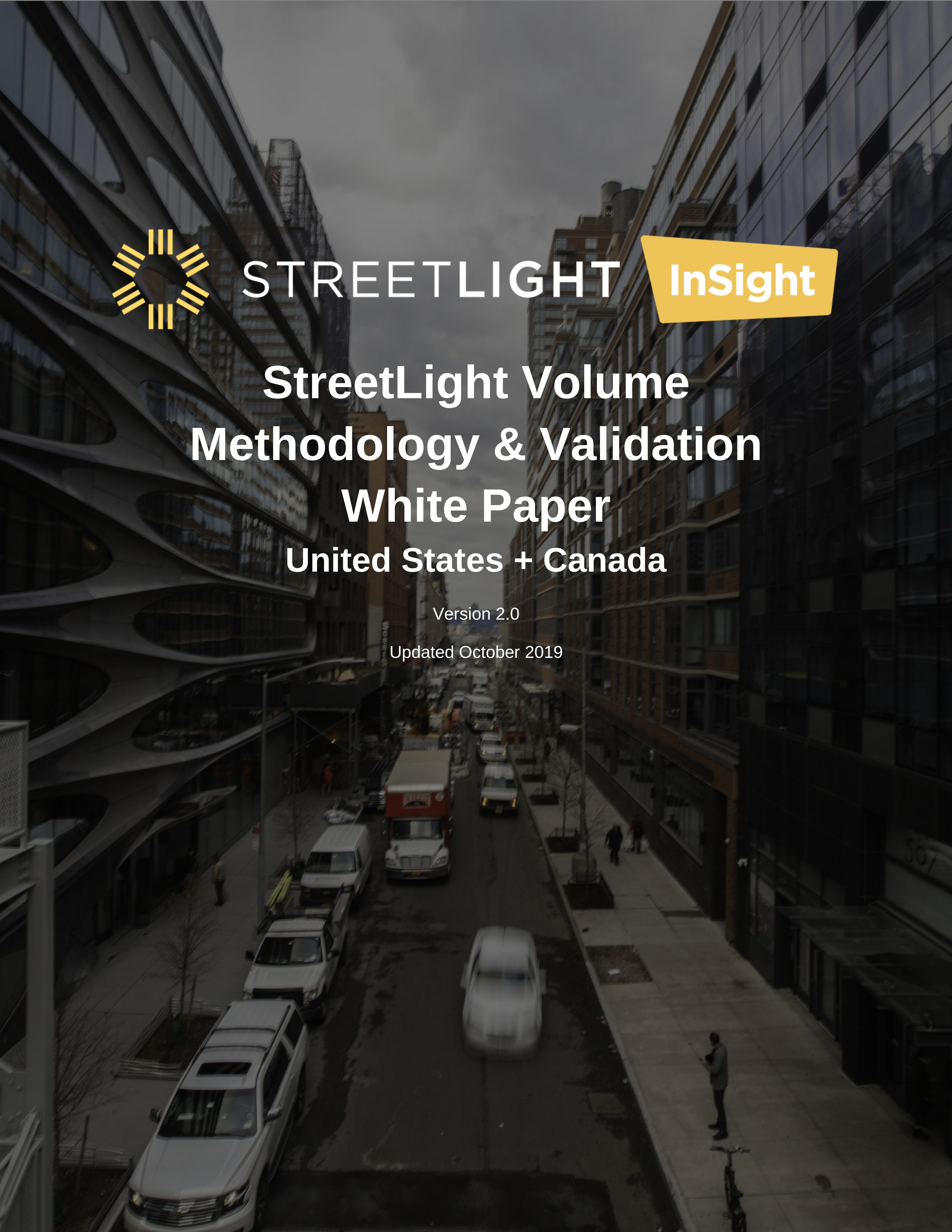

STREETLIGHT InSight

StreetLight Volume Methodology & Validation White Paper

United States + Canada

Version 2.0

Updated October 2019

STREETLIGHT

This white paper provides technical detail about the methodology, algorithm development, validation, and data sources used in StreetLight's Volume output. This white paper was first published in October 2019 and is updated periodically as new validation is performed.

Table of Contents

Introduction

StreetLight's underlying data sample varies month to month, and the resulting trip counts and normalized Index values, while valuable for cross zone or cross project comparison, these values do not represent estimated trip counts. The goal of the new StreetLight Volume output is to provide an estimate of average daily traffic, and to allow for time-series analysis, or comparison of actual traffic changes over time. This Volume output provides a quick, easy, and cost-effective way to measure traffic at the yearly, monthly, daily, and even hourly level. Volume estimates can be derived for any location, such as a road, park, TAZ or user-defined special area. It can also be used to estimate zone-to-zone traffic, providing accurate estimates for work like turning movement studies and travel demand models. StreetLight Volume is available for analyses in the U.S and Canada.

Methodology

Estimated Volume for Roads

Data Sources

In order to create an estimate of the actual number of cars on the road at a variety of points in time, the analysis combined multiple models to create optimal results. At a high level: StreetLight's machine-learning models predict expected seasonal changes at a location over time, and use the StreetLight AADT (annual average daily traffic) to calibrate seasonal changes to an estimated volume.

Following is a brief overview of StreetLight AADT methodology and data sources. To get more detailed information, please refer to the StreetLight AADT white paper.

StreetLight AADT blends together the following data sources to provide the best prediction of annual average daily traffic at a given location:

- Location-Based Services trips.
- Navigation GPS trips - personal and commercial.
- Demographics derived from the U.S. Census and Manifold Data Mining in Canada.
- Open Street Maps data reflecting road classification, density of commercial activity, and more.
- Weather data.
- AADT counts, derived from permanent traffic recorders, including a mix of small and large, urban and rural locations. StreetLight uses 11,000+ counts across the U.S. and Canada to develop and validate AADT.

Using a combination of the features described above, a Random Forest model was created to estimate AADT. Cross-validation was used to measure model performance across a variety of contextual variables (across states, road types etc.). The StreetLight AADT model has a high R^2 (.96), with low bias.

In order to estimate variation in traffic volume across time, analysis relied on permanent traffic recorders (PTR) deployed on roads across the U.S. which continuously count the number of cars. This constant counting allows StreetLight to evaluate monthly average daily traffic (MADT) metrics to assess monthly variation in trip volume at a particular location.

Creating a monthly traffic model demanded promptly published data on how many cars were historically present on a road each month. In the U.S., quality data at the monthly level is not readily available from all states, thus StreetLight had to narrow PTR counters to those that met a high standard of frequency and quality. This left 474 counters across eight states: Colorado, Georgia, Indiana, Michigan, Massachusetts, Montana, Ohio, and Rhode Island. This is a subset of those used in the AADT calibration process. In Canada we use data from Alberta and British Columbia, a total of 536 locations.

Algorithm Details

With the MADT data derived from counter locations across the U.S. and Canada, a distinct linear model was trained and generated for each month of the year. Using a series of spatial and temporal features, the linear model predicts a seasonal factor for the expected change in average daily traffic for that month relative to the daily average over all of 2018 (AADT). Seasonal factors are represented as a percent change from the 2018 AADT, so a month with more traffic than the AADT will have a positive seasonal factor (say +10%), while a month with less traffic than the AADT will have a negative seasonal factor (say -15%).

The resulting model allows us to ingest monthly data samples that vary in size, and then predict monthly trip volumes that correspond with seasonal variation. In Figure 1, LBS trips at a single location are translated into “seasonal change” in LBS across months (left, green). In running the model, the seasonal factor can be translated into MADT or StreetLight Volume (right, orange).

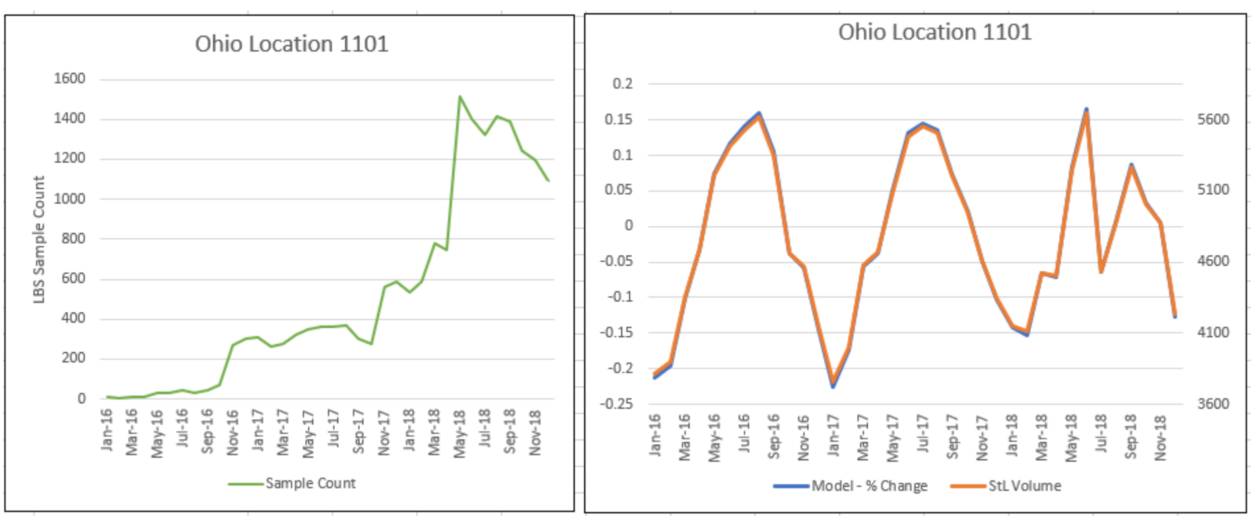

Figure 1: Unadjusted LBS sample trip counts (left) show sample growth over time vs. MADT model output (right), which corrects and normalizes the input data.

Estimated Volume for Areas

Data Sources

Calibrating LBS data to the volume of large areas is less straightforward than calibrating to expected road volume without reliable "truth" data representing the real-world number of trips that start or end in large areas. The most consistent and reliable validation and training data available is for roads. Thus, StreetLight used its well-validated method of estimating traffic on roads to infer expected volume to areas.

In order to estimate trips to or from an area, the process followed this high-level method:

1. Sample nearby roads with trips in the zone area.
2. Obtain an estimate of MADT for the sampled road, as described previously.
3. Use the estimated MADTs from the roads near the area to calibrate and generate an estimate of volume in the area.

Algorithm Details

In order to estimate volume for a specified area, the algorithm selects a subset of roads with trips that start, end, or pass through the zone area. See Figure 2 for an example, where a specified area (shaded) is accompanied by a subset of randomly sampled roads (red gates) in the surrounding area. The number of sample roads will depend on the size and location of the area zone.

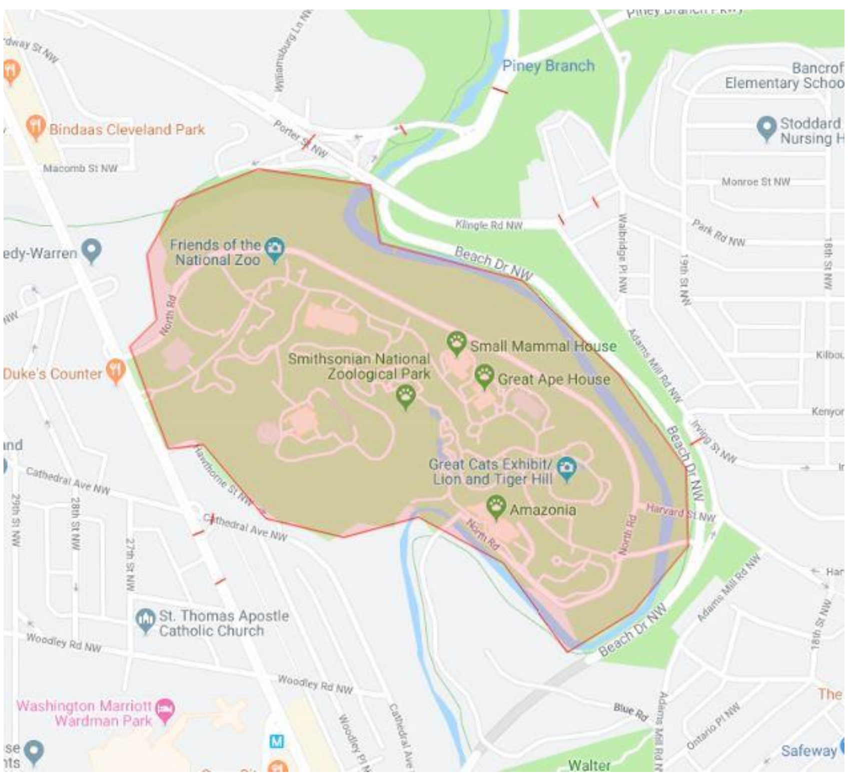

Figure 2: Example area zone with selected gates (red lines) used to calculate MADT for trip starts and stops to the area.

For each sampled road, the system will do the following:

1. Run a pass-through Zone Activity analysis for an estimate of MADT from each sampled road.
2. Use the ratio of LBS through the road, and LBS trips through the zone area to estimate zone area volume. This is based on the assumption that: LBS road trips/LBS area trips= actual road volume /actual area volume.
3. Calculate the weighted average volume estimate from all the sub-sampled roads to choose a final estimated StreetLight Volume.

Based on seasonal factors associated with the months included in the analysis, this results in an estimated volume for the defined area based on trip starts and ends.

Estimated Volume for Origin-Destination Analyses

Once Volume outputs were estimated for individual zones (both pass-through and area zones) these were applied to origin-destination analyses, which allowed for evaluating how many trips span between locations. The goal is to generate an O-D Volume that allows for comparisons across time, and provides a number that represents a reasonable estimate of the real-world number of trips.

This was accomplished via the following approach:

1. Calculate the total Zone Activity Volume for each Origin and Destination zone (described in the previous sections).
2. Return the LBS trip counts between each O-D zone pair.
3. Use Iterative Proportional Fitting (IPF) to scale the LBS O-D counts to Volume based on the estimated volume at each O-D.

Iterative Proportional Fitting is a technique used to adjust the counts in a table so that they add up to specified totals (or "marginal totals") for both columns and rows. In this case, the adjusted data (called "seed" cells) is the LBS trip counts between each O-D pair. Using an adjusted Zone Activity Volume for each O-D as the marginal totals, then scaling the LBS trip counts with IPF, adds up to the expected Zone Activity Volumes. This approach follows well-established practices in the transportation industry.[1]

In addition to a two-dimensional matrix used in an O-D project, the IPF technique can also be applied to a three-dimensional matrix to derive volume estimates for an Origin-Destination with Middle Filter (ODMF) zone configuration.

[1] CDM Smith, A. Horowitz, T. Creasey, R. Pendyalam, and M. Chen. NCHRP Report 765: *Highway Traffic Data for Urbanized Area Project Planning and Design*. TRB, National Research Council, Washington, D.C., 2014. Pg 161

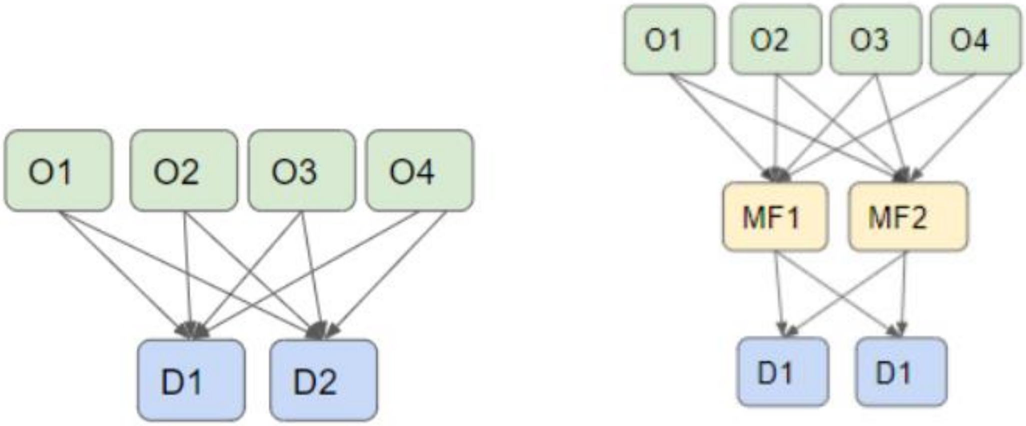

Figure 3: Example Origin-Destination analysis configuration (left) and Origin-Destination analysis with Middle Filter configuration (right) used in IPF calculations.

Validation

Zone Activity Volume for Roads

Data Sources and Methods

In order to validate monthly Volume output, we created a zone set that contained 495 permanent counter locations across the continental U.S. These locations were not used to train the original model, but had sufficient MADT data reported across time so they could be used as a direct point of comparison. These locations, obtained from state DOTs, included counters dispersed across 15 U.S. states, including urban, suburban, and rural locations, as well as a variety of road sizes and classifications. Figure 4 shows those zone locations.

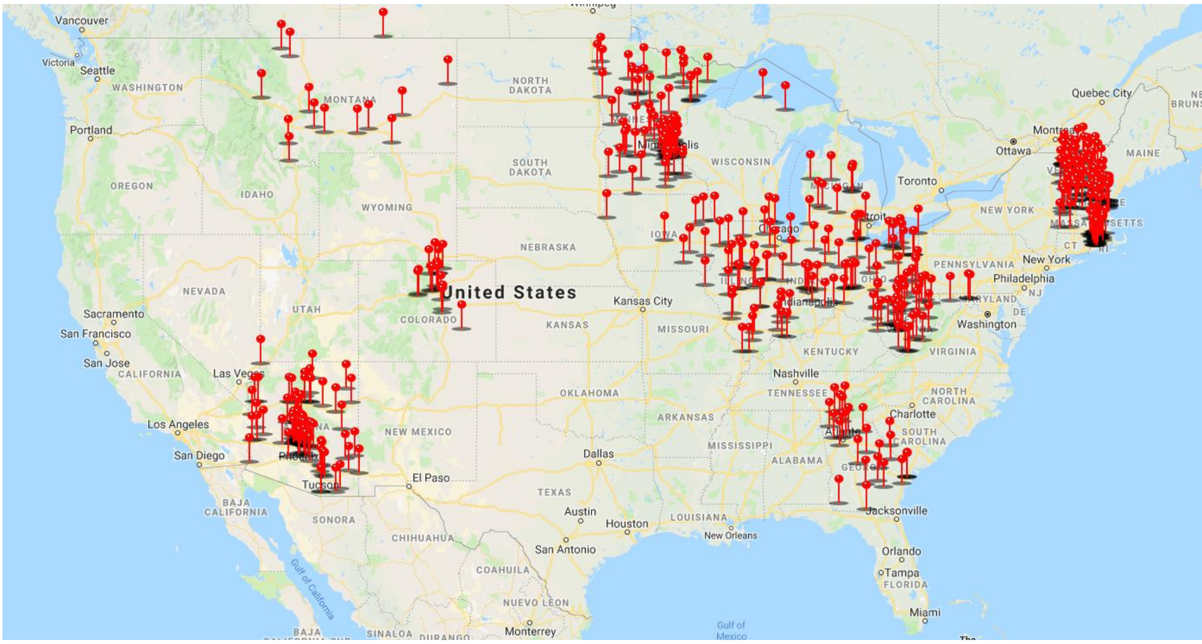

Figure 4: Counter locations across the U.S. used for MADT validation.

In the U.S., validation was performed using these 495 counter zones in a series of Zone Activity Volume analyses within StreetLight InSight® for each calendar month from 2018. StreetLight Volume results were directly compared to the MADT values for accuracy. In total there were 5074 data points for comparison (each counter included data for a subset of months with 2018, but not necessarily all months within the calendar year).

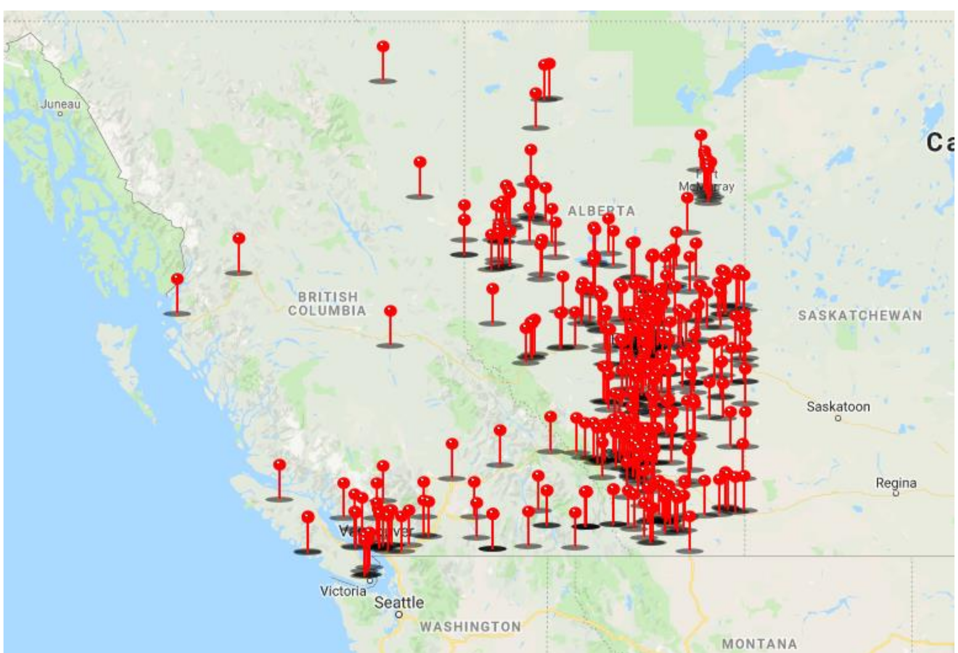

Figure 5: Counter locations across Canada used for MADT validation.

In Canada, we collected 350 unique sites across British Columbia and Alberta, Canada, which had MADT data across 2016, 2017 and 2018. This resulted in more than 11,000 points for comparison. These counter locations were used to both train and validate our MADT model. We ran k-fold Cross Validation (K=5) on both our 2018 AADT and MADT model estimations to evaluate our model.

VALIDATION RESULTS: ZONE ACTIVITY VOLUME

In the U.S., directly comparing the StreetLight Volume results to the reported MADT, there is a very high correlation. With no outlier deletion, the R^2 value is 0.98, indicating a strong relationship between StreetLight Volume estimates and real-world counts.

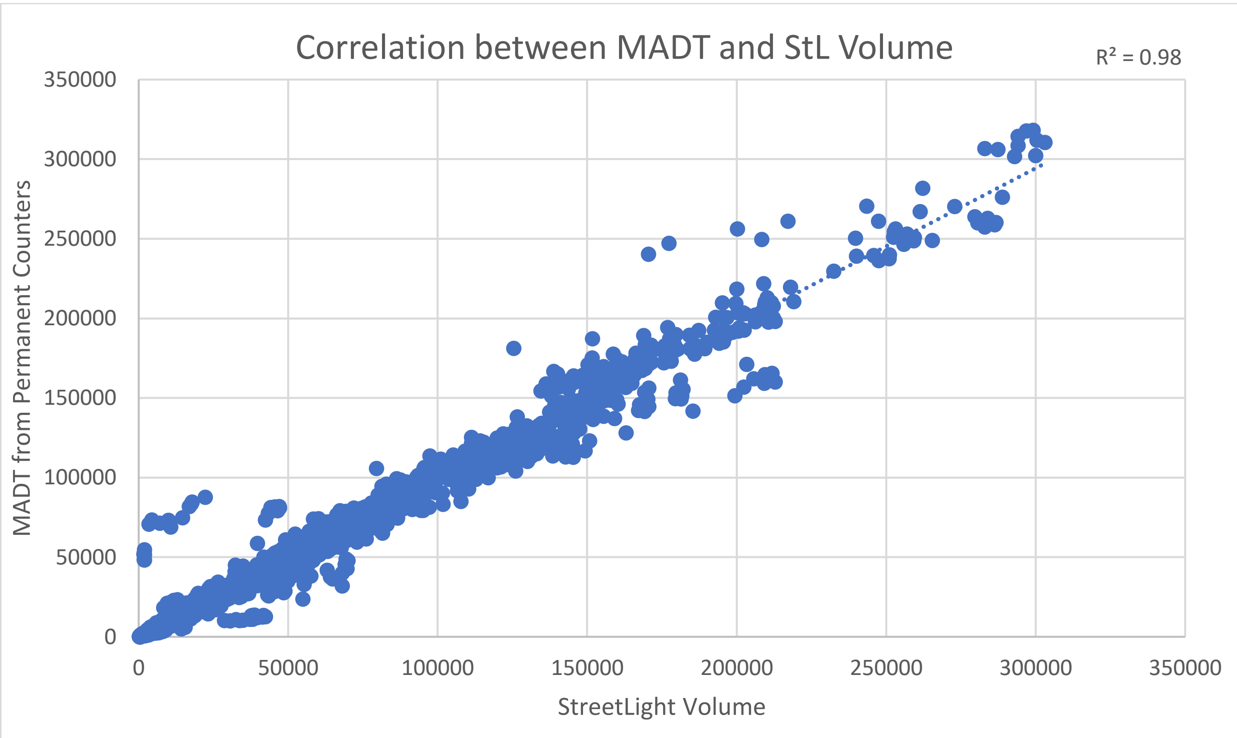

Figure 6: StreetLight Volume compared to published MADT values. No outliers were removed.

In Canada, results are similar with an R^2 value of 0.97.

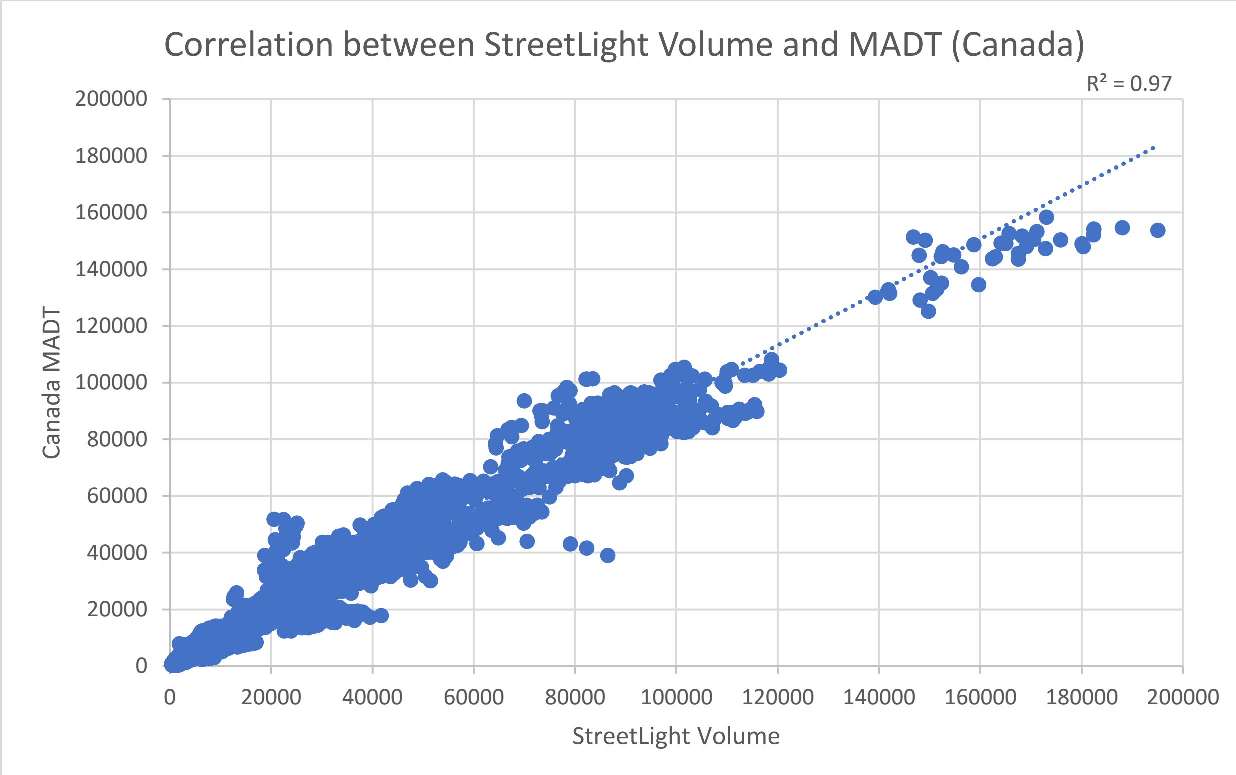

Figure 7: *StreetLight Volume compared to published Canadian MADT values. No outliers were removed.*

In addition to correlation, we also evaluated the mean absolute percentage error (MAPE) and root means square error as percent of average MADT (RMSE as %) by road size, expecting to have more accurate estimations on larger roads with higher MADT values. Table 1 compares the MAPE to published target errors[2,3,4] and Table 2 compares RMSE to published target errors. **The results fall within the target error range across all road sizes.**

[2] Krile, R. (2016). Assessing Roadway Traffic Count Duration and Frequency Impacts on Annual Average Daily Traffic Estimation (No. FHWA-PL-16-012). Retrieved from US Department of Transportation, Federal Highway Administration website: https://www.fhwa.dot.gov/policyinformation/travel_monitoring/pubs/aadt/aadt_task_4_final_report_feb_2016.pdf

[3] Cambridge Systematics. (2010). Travel Model Validation and Reasonableness Checking Manual—Second Edition (No. FHWA-HEP-10-042). Retrieved from US Department of Transportation, Federal Highway Administration website: https://www.fhwa.dot.gov/planning/tmip/publications/other_reports/validation_and_reasonableness_2010/index.cfm

[4] See Table 2 in: Gadda, S., A. Mangoon, and K. Kockelman. *Estimates of AADT: Quantifying the Uncertainty*. 11th World Conference on Transport Research, Berkeley CA, 6-24-2007 to 6-28-2007.

Road Size	US Road Count	Canadian Road Count	Target MAPE	MAPE US	MAPE CA
<2.5K	594	4265	Not available	31%	30%
2.5K-5K	586	2582	Not available	12%	18%
5K-10K	1011	2097	20%	15%	15%
10K-25K	1336	1428	20%	13%	17%
25K-50K	647	908	16%	10%	16%
50K+	900	701	12%	8%	11%

Table 1: StreetLight Volume in US and Canada. MAPE compared to targets across road sizes. US and Canadian locations fall within target error ranges.

Road Size	US Road Count	Canadian Road Count	Target RMSE/Average MADT	RMSE/Average MADT US	RMSE/Average MADT CA
<2.5K	594	4265	47%	37%	34%
2.5K-5K	586	2582	36%	17%	25%
5K-10K	1011	2097	29%	20%	23%
10K-25K	1336	1428	25%	25%	26%
25K-50K	647	908	22%	17%	22%
50K+	900	701	21%	13%	13%

Table 2: StreetLight Volume in US and Canada. RMSE/Average MADT compared to targets across road sizes. US and Canadian locations fall within target error ranges.

Validation Results: Seasonality

In addition to evaluating the direct comparison between StreetLight Volume output and MADT across all locations, the analysis also examined some specific locations to validate the model's ability to accurately capture seasonal trends. Counter locations were randomly selected that had 11 or 12 monthly counts in 2018. In comparing results, trend lines reflected a similar seasonal pattern, while also being closely aligned in volume.

Testing both high- and low-volume roads confirmed the ability to report seasonal trends across all types of locations. Figure 8 below shows a higher volume road (~20K MADT). In this case, the StreetLight Volume estimate aligns very closely with the MADT values.

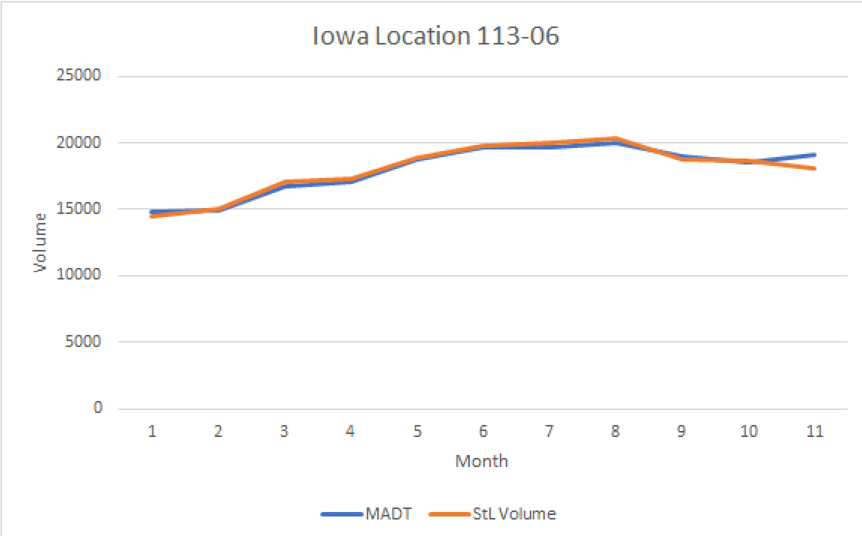

Figure 8: Monthly variation in StreetLight Volume and MADT across 11 months in 2018 – sample high-volume Iowa location. StreetLight Volume and MADT are closely aligned.

Figure 9 depicts a very low-volume rural road in Montana with an MADT range between 200 and 1000 across the year. In this case, while slightly less extreme than the reported MADT numbers, the StreetLight Volume is still able to capture the seasonal peaks very accurately, with lows in the winter months and clear peak in July. These results give confidence in the model's ability to accurately predict seasonal trends, even when locations experience low-traffic volumes.

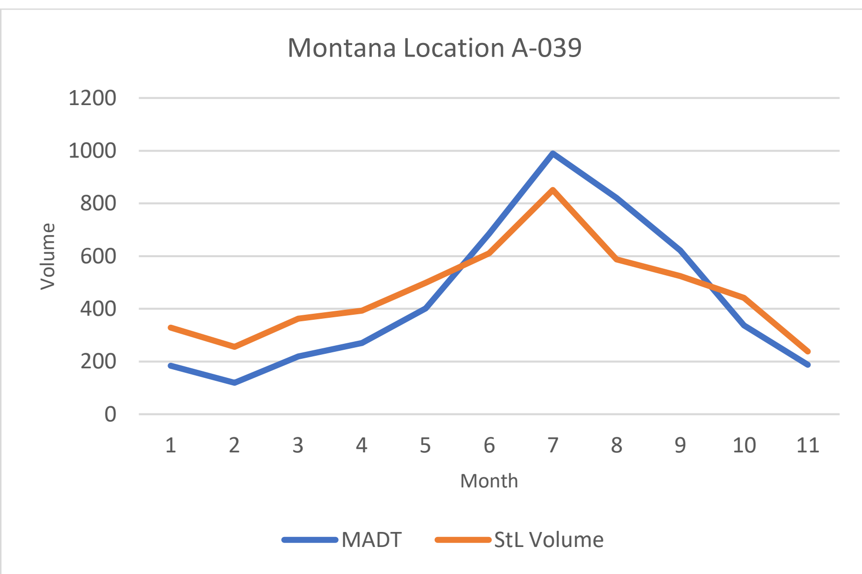

Figure 9: Monthly variation in StreetLight Volume and MADT across 11 months in 2018 – sample low-volume rural Montana location. StreetLight Volume and MADT are aligned showing the same summer peak.

Canadian locations show similarly strong results across both high and low volume roads.

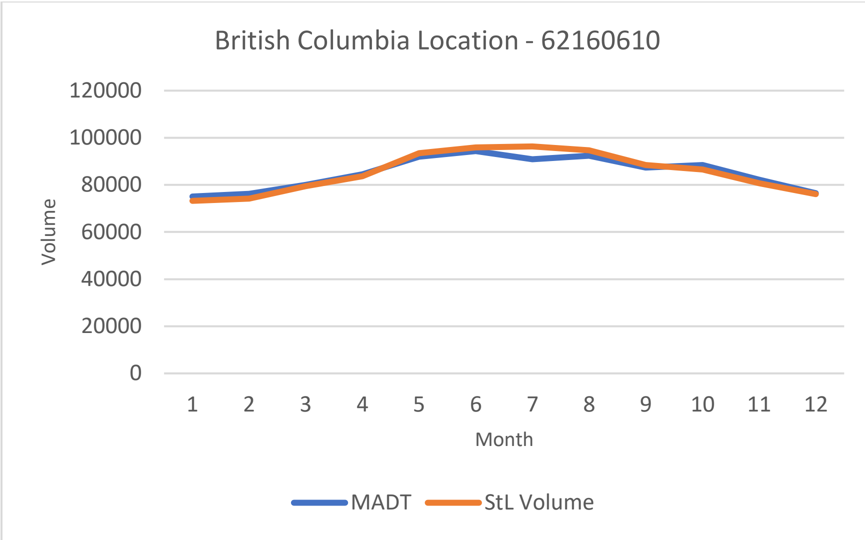

Figure 10: Monthly variation in StreetLight Volume and MADT across 12 months in 2018 – sample high-volume British Columbia location. StreetLight Volume and MADT are closely aligned.

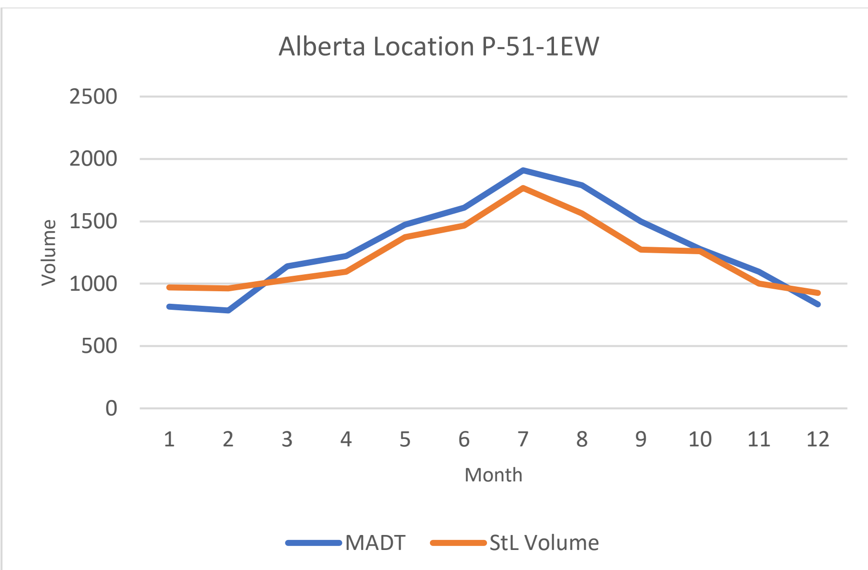

Figure 11: Monthly variation in StreetLight Volume and MADT across 12 months in 2018 – sample low-volume Alberta location. StreetLight Volume and MADT are aligned showing the same summer peak.

Origin-Destination Volume for Roads

DATA SOURCES AND METHODS

For validating Volume performance in an O-D analysis, StreetLight Volume results were compared to turning-movement counts published by Hennepin County in Minnesota[6] and Alberta, Canada's Ministry of Transportation[7]. A turning movement is an O-D study where each

[6]http://hennepin.maps.arcgis.com/apps/webappviewer/index.html?id=14c650982d904132a4854f399c71e1f2
[7] https://www.alberta.ca/highway-traffic-counts.aspx

inbound road is the origin and each outbound road is the destination. Turning movements were chosen because validation data for turning movement studies is far more readily available than other types of O-D data.

In Minnesota, the validation used data from five locations throughout the county, all of which were gathered on different dates in 2017. For each location, trips were manually counted between 6:00 a.m. and 6:00 p.m. In Alberta, the validation used data from three locations throughout the province, all of which were gathered on different dates in 2018. For all three locations, counts were gathered over a 24-hour period.

In order to perform a direct comparison between the U.S. and Canadian locations and the StreetLight Volume output, we created zones in the *StreetLight InSight* platform that mirrored these eight intersections. Then the platform ran an O-D analysis for the calendar month, structuring the query to match the specific weekday and hourly period from which the data were collected. For example, if site A used a Tue-Thu 8:00 a.m. to 10:00 a.m. definition of peak, the validation also used this definition of peak. The analysis closely mirrored the original study for direct comparison of turning movement counts and ratios.

VALIDATION RESULTS: ORIGIN-DESTINATION VOLUME

At each of the locations, data was evaluated for east, west, north, and southbound traffic as the origin, with left, right, and thru traffic as the destination. For the U.S. zones, this created 60 data points for comparison. Without deleting any outliers, there was a high correlation between StreetLight Volume and the Hennepin turning movement counts, with an R^2 value of 0.95.

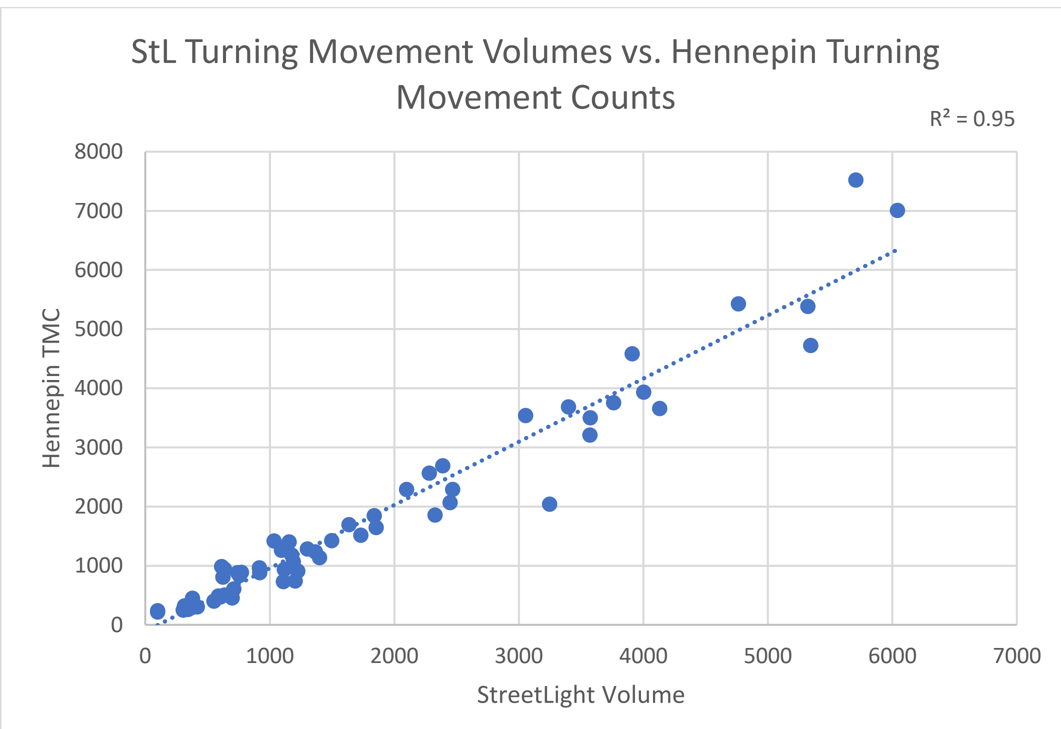

Figure 12: Correlation between Hennepin turning movement counts and StreetLight Volume. R^2 value of 0.95 indicates high correlation.

For the Alberta locations, there were 36 points for comparison, with an R^2 value of 0.88.

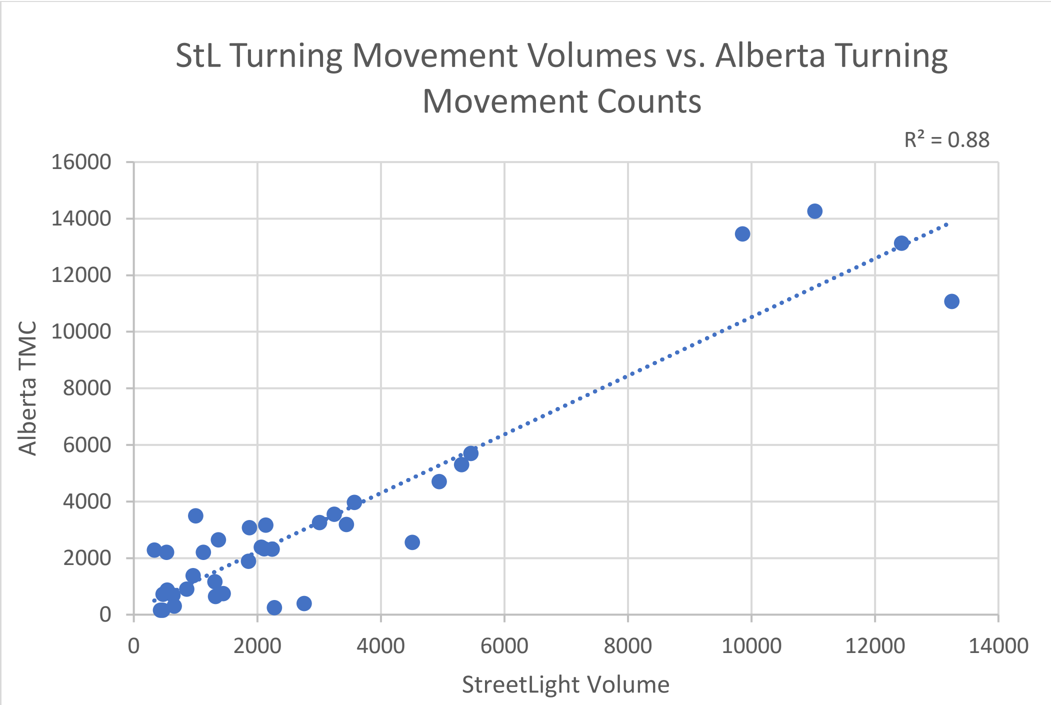

Figure 13: Correlation between Alberta turning movement counts and StreetLight Volume. R^2 value of 0.88 indicates good correlation.

The U.S. analysis also directly compared the turning movement ratios, represented as percentages of total origin zone traffic that traveled left, right, or directly through the intersection. The correlation for turning movement ratios was even higher, with an R^2 value of 0.98.

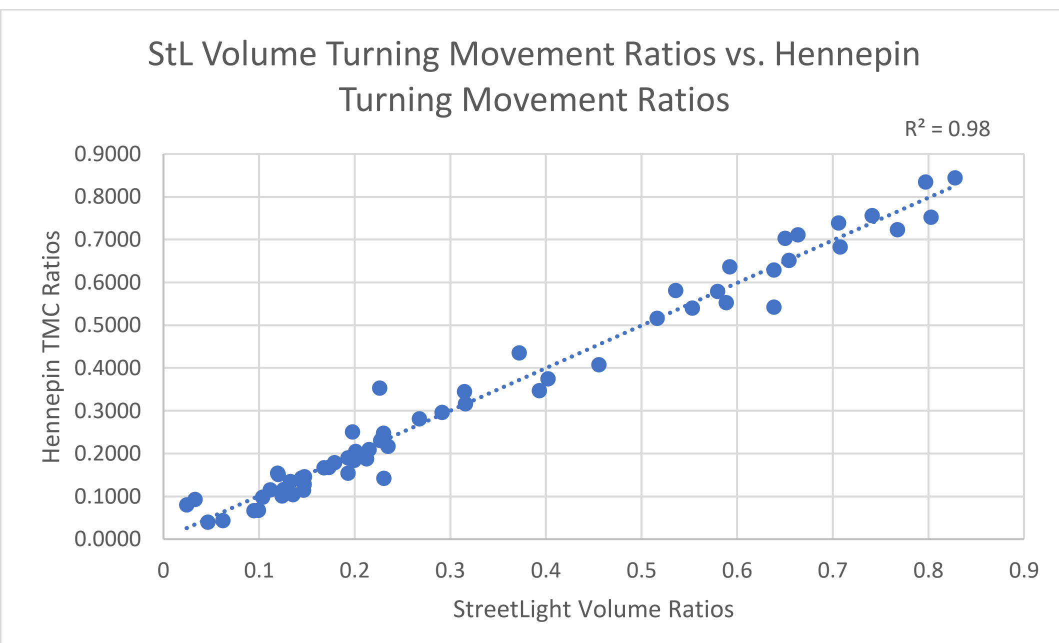

Figure 14: Correlation between Hennepin turning movement counts and StreetLight Volume. R^2 value of 0.98 indicates very high correlation.

Turning movement counts also fell within expected MAPE and RMSE/Average Count targets based on road size.

Road Size	Target MAPE	MAPE	Target RMSE/Average Count	RMSE/Average Count
<2.5K	Not available	19%	37%	22%

Table 3: MAPE and Target RMSE/Average Count for Hennepin Turning Movement counts compared to targets.

The image below illustrates an individual intersection in Hennepin County, Minnesota and the comparison between StreetLight Volume and turning movement counts along with turning movement ratios. Turning movement counts are very close, while turning movement ratios are nearly identical.

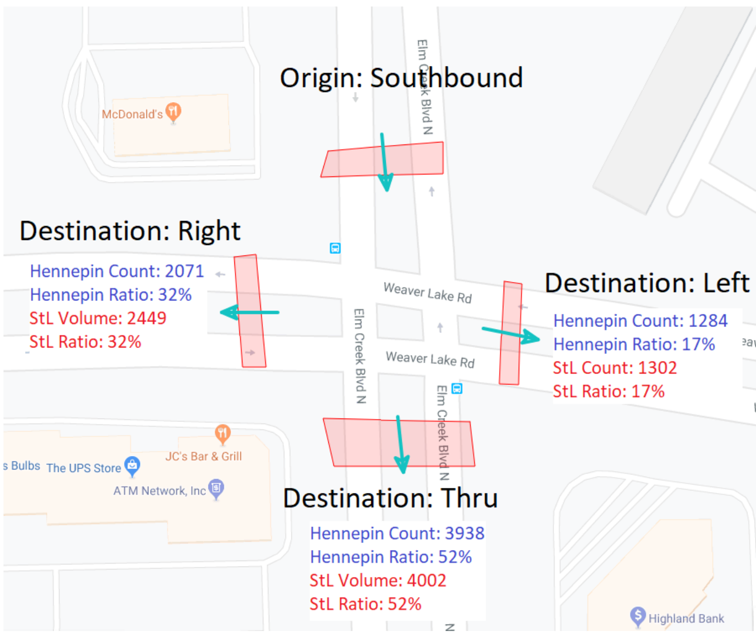

Figure 15: Southbound turning movement counts and ratios at location 4538. Counts and Turning ratios are very closely aligned between StreetLight Volume and published counts from Hennepin County, MN.

Compared to estimating turning movements from manual counts over one day, the StreetLight Volume estimations samples from counts over an entire year or month, allowing for a greater sample over time and conditions. We achieve very similar results to traditional methods, with a dramatically faster analysis time window – hours, as opposed to days.

Overall, these results are very promising and suggest that StreetLight Volume reliably captures seasonal trends, as well as O-D patterns on roads.

Zone Activity Volume for Areas

Data Sources and Methods

In the prior sections of the validation, we could rely on MADT and other published trip count sources for a direct comparison to StreetLight Volume. Real world count data is less readily available for predefined areas, like Zip Codes, Census Tracts or TAZs. And real-world Origin-Destination patterns are even harder to come by. As a result, we determined our best source for comparison of StreetLight Volume of areas would be Household Travel Surveys with survey-expanded trip counts describing travel patterns throughout a region. Note – as discussed below, both survey-expanded counts and StreetLight Volumes are types of sampled data that's been put through an expansion process. Neither are "real world" or "ground truth." However, convergence on metrics in aggregate from both methods can increase our confidence in the correctness of StreetLight Volume, and any differences can reveal interesting pros and cons of the two different approaches.

For this portion of the validation paper, we relied on the household travel survey published by Puget Sound Regional Council[8], which reports travel patterns in the Seattle region across Spring 2017. Trips included in the Puget Sound Regional Council (PSRC) travel survey were aggregated over a three-month period including April, May, and June 2017. We selected a subset of roughly 100 Census Tracts within the City of Seattle for comparison to our volume metrics. Figure 16 illustrates those Census Blocks in the StreetLight platform.

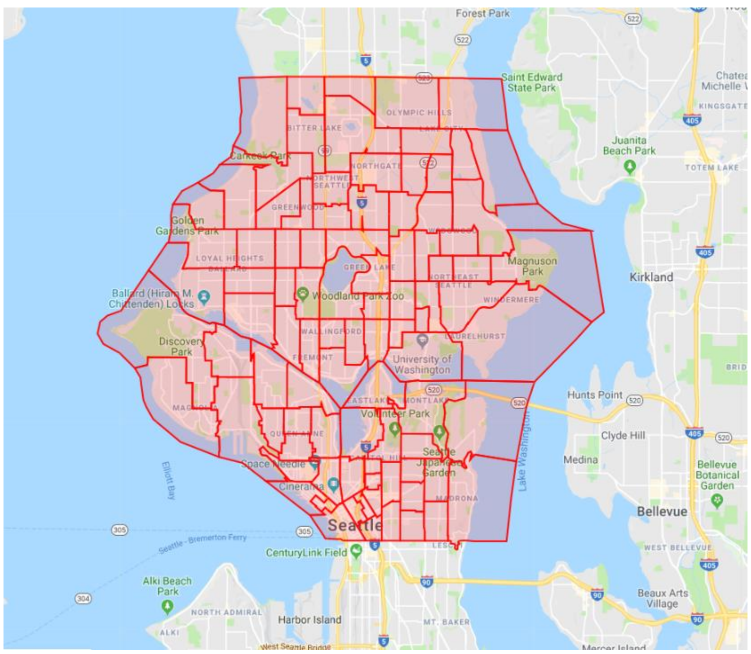

Figure 16: Seattle Census Tracts selected for validation work.

We used only vehicular trips within the PSRC survey in order to match the Volume metric which ultimately represents vehicle estimates. StreetLight Volume metrics were compared to expanded PSRC survey vehicle trips, which were weighted based on correction factors implemented by PSRC.

[8] https://www.psrc.org/household-travel-survey-program

Before performing a direct comparison between the two data sources, we acknowledge some inherent differences between the way travel surveys are conducted and the way “big data” and the StreetLight trips specifically operate:

- Household travel surveys collect data on a very small sample of respondents, and thus rely heavily on weighting in order to expand the sample to population. Trip weights within the PSRC survey vary dramatically from 0 to 23,500.
- Surveys may define or report trips differently than StreetLight. StreetLight ends a trip if a device doesn’t move approximately five meters in five minutes, meaning StreetLight trips may be shorter than those reported in surveys which may ignore short breaks, like stopping for gas, coffee, etc.
- Surveys often rely on memory, or self-reported tracking, and thus may not capture all trips included in the StreetLight metrics, including shorter trips, non-work trips, trips made by active transportation modes and trips that compose a larger tour.
- Reliance on memory and self-reporting in surveys also induces errors in trip start and end times, and trip duration and length.
- Surveys are conducted over a period of several weeks or months, with an individual reporting trips they made over a day or up to a week within the survey period. In contrast, StreetLight trips are sourced from data collected each day within the survey period.
- StreetLight’s sample size (978,000 trips across the Tracts used in this comparison) was more than 40x larger than the PSRC survey (24,677 across the Tracts used in this comparison) for the same three study months.

A small number of PSRC trips with expansion weights greater than 10,000 were removed in order to exclude survey record types with extremely small sampling or unreasonably large expanded counts.

VALIDATION RESULTS: ZONE ACTIVITY VOLUME FOR AREAS

PSRC weighted trips that started within the selected Census Tracts were directly compared to the StreetLight trips that started within the same areas. Overall, travel patterns appeared similar across the two sources, with an R^2 value of 0.79.

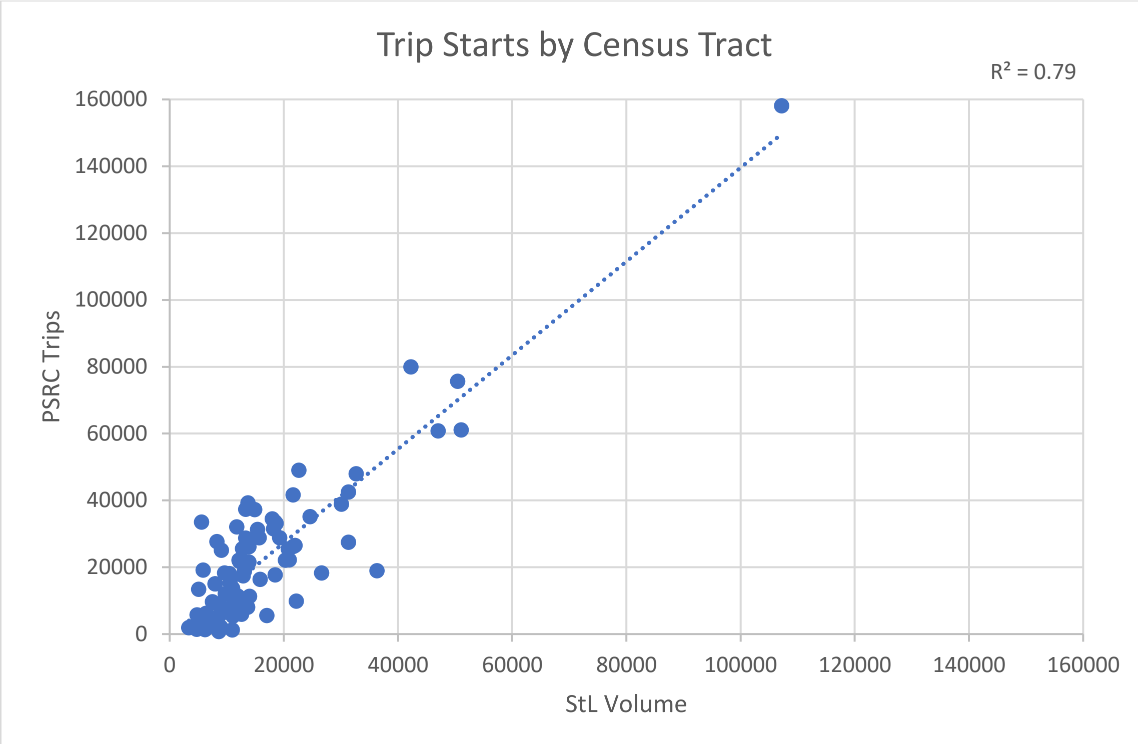

Figure 17: Correlation between StreetLight Volume and PSRC vehicular trip starts. R2 = 0.79. PSRC volume of trips is consistently higher that StreetLight volume. As discussed below, we find that PSRC is overweighting trips in their expansion.

In evaluating the correlation between the two datasets, we noticed that StreetLight Volume was on average lower than vehicular trips reported by the PSRC survey. Based on our trip definitions and our understanding that StreetLight is more likely to include more short trips, we found this relationship unexpected.

In order to investigate this further, we considered the total population of the selected Census Tracts. According to the 2017 ACS (Amercan Community Survey), the estimated population for the selected Census Tracts was 480,415[9]. Multiplying this by 3.37, the average daily trips per person by NHTS in 2017[10], we can estimate a total number of daily trips in the region to be 1,618,998.

Type	Total Trip Starts	Derived Trips Per Person (target 3.37[10])
StreetLight Volume	1,454,958	3.03
PSRC Tracts - All	2,483,829	5.17

Table 4: Comparison of total trips reported and derived trips per person between StreetLight and PSRC. StreetLight Volume is closer to targets defined by NHTS.

The expected trip estimate (1,618,998) was compared to the total number of trips derived from StreetLight Volume, and the total PSRC trips. The StreetLight Volume estimation of daily trips

[9] https://factfinder.census.gov
[10] https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf

per person is much closer to the target of 3.37 than the PSRC value, which estimates between over five trips per person per day (note – even excluding the 10,000+ weighted zones still yielded a trips/per/day value of over four). **Based on this, we hypothesize that PSRC is over-weighting trips, leading to comparitively higher trip counts, as compared to the StreetLight Volume, thought both show the same relative trend tract to tract.**

Overall, the StreetLight Volume metrics provide correlative activity trends across a region compared to estimation using traditional survey methods. Our StreetLight Volume is derived from LBS data that is sampled from a much larger population base, and is availible for the entire U.S. and Canada with a click of the button, making our metric an invaluable tool for analyzing trip activity across regions.

Origin-Destination Volume for Areas

DATA SOURCES AND METHODS

To validate StreetLight Origin-Destination Volume for areas, we relied on the same PSRC household travel survey data described earlier. Instead of comparing Origin or Destination zone trip starts, we compared trip activity between O-D tract pairs. We required that both the origin and destination tract fell within the designated Seattle area in order to a trip to be included in the comparison.

Rather than directly comparing tract to tract origin-destination patterns, we aggregated tracts into larger “compound zones” in order to minimize compounding error that might occur due to the differences in trip definitions between the two sources, described in the last section. This resulted in a 10 x 10 matrix for comparison.

VALIDATION RESULTS: ORIGIN-DESTINATION VOLUME FOR AREAS

Patterns were compared across O-D pairs resulting in an R^2 value of 0.87, indicating a strong relationship between estimations from StreetLight Volume estimates and weighted survey trips.

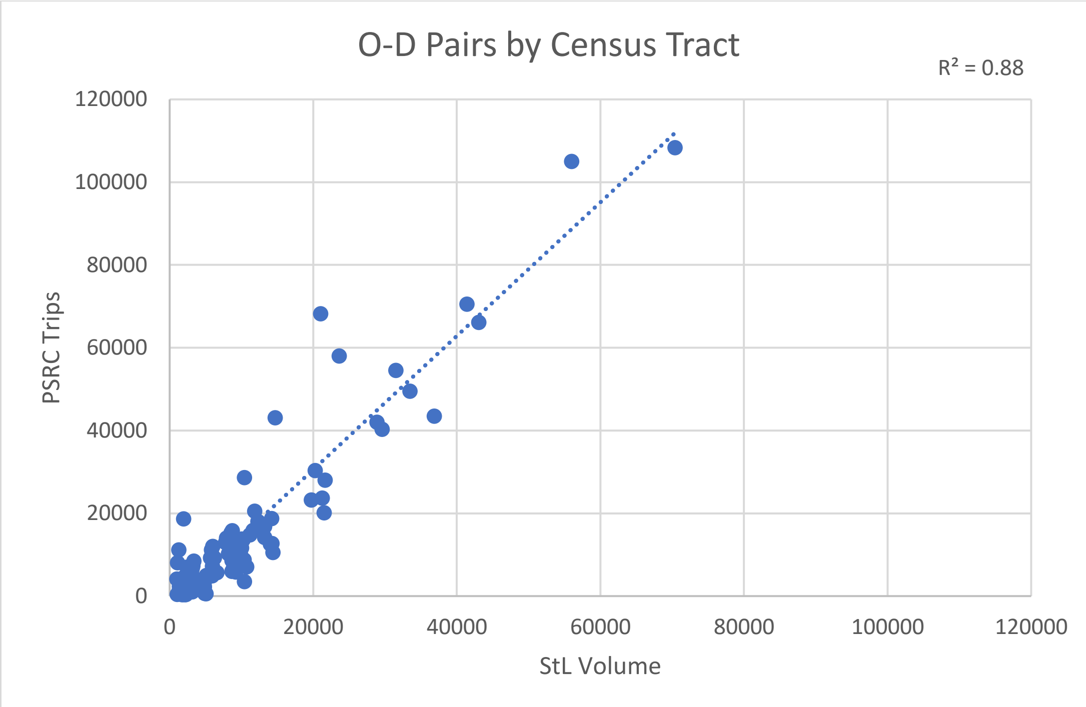

Figure 17: Correlation between StreetLight Volume and PSRC trips across aggregate area O-D pairs. As discussed earlier, we find that PSRC is overweighting trips in their expansion.

O-D matrices of estimated trip counts depict similar travel patterns between the two surveys (Figure 18). Both surveys estimate zones 5,6, 8 and 9 to have some of the highest intra-zonal trip counts, and estimate zones 1 and 10 to have some of the lowest inter-zonal trip counts.

StreetLight Volume

	1	2	3	4	5	6	7	8	9	10
1	29576	14196	7794	4868	5995	5103	1701	3146	2420	1327
2	14262	23628	9993	9883	8539	5707	2311	4000	2591	1063
3	7918	9952	14705	10055	10319	6574	2213	3026	2371	1020
4	5078	9890	10232	21525	21242	10719	3580	4812	3529	1563
5	6230	8672	10418	21654	41419	31503	8664	8538	5051	1956
6	4829	5947	5906	10359	28894	70380	11611	13206	8171	3078
7	1756	2177	2044	3540	8905	11833	21032	20257	8554	3363
8	3163	4195	2945	4811	8720	13234	19722	55973	33453	14014
9	2680	2970	2691	3818	5816	9217	8983	36860	43067	12271
10	1381	1289	1099	1371	2208	3156	3247	14365	11185	10410

PSRC Trips

	1	2	3	4	5	6	7	8	9	10
1	40291	18737	12944	608	12013	4991	506	998	2365	1250
2	12670	58005	11623	12458	12577	9217	390	2084	2191	373
3	14049	12717	43062	13783	8380	5687	3903	4905	6939	4107
4	596	9984	13587	20107	23636	7056	4078	2666	2283	2317
5	9190	5951	3500	28031	70554	54553	8574	15245	4190	18636
6	2148	7204	4907	8759	41982	108351	15864	16818	10214	6126
7	349	329	4581	2356	6905	20511	68225	30319	13809	8423
8	2108	2774	4171	4084	15788	14188	23195	105006	49477	12575
9	2980	3511	5570	1779	11157	5804	13902	43492	66101	18049
10	2214	11144	8078	2497	3594	6675	7285	10541	14758	28633

Figure 18: Comparison of matrices for StreetLight Volume and PSRC Trips. In each matrix, aggregate area origin numbers appear as rows (1-10) and destinations appear as columns (1-10). In each matrix, blue indicates the lowest values and red indicates the highest values.

Despite the challenges of comparing big data to household travel surveys, we were pleased to find that StreetLight Volume results indicate similar travel patterns as a household travel survey. These results support the use of *StreetLight InSight as* a valuable tool for estimating O-D patterns and volumes. Compared to travel surveys, StreetLight samples from a much larger population of trips, and the data is readily available for any region across the United States and Canada, and for any chosen month(s) in a year and time of day supported in the *StreetLight InSight* platform.

StreetLight welcomes any partner who has empirically measured trip counts for area zones to share them for the purposes of validation.

About StreetLight

StreetLight pioneered the use of Big Data analytics to help transportation professionals solve their biggest problems. Applying proprietary machine-learning algorithms to over four trillion spatial data points, StreetLight measures diverse travel patterns and makes them available on-demand via the world's first SaaS platform for mobility, StreetLight InSight®. From identifying sources of congestion to optimizing new infrastructure to planning for autonomous vehicles, StreetLight powers more than 3,000 global projects every month.

STREETLIGHT