Presentation of Project Findings
(Agreement Number 74A1119)

Improve Traffic Census and Highway Performance Monitoring Programs

UC Berkeley – ITS/PATH

Tuesday, December 15, 2020

Project Schedule & Deliverables

Figure 1. PROPOSED PROJECT TIMELINE & SCHEDULE (12 MONTHS)

Task #	Project Deliverables/Tasks	15-Jun-19	15-Jul-19	15-Aug-19	15-Sep-19	15-Oct-19	15-Nov-19	15-Dec-19	15-Jan-20	15-Feb-20	15-Mar-20	15-Apr-20	15-May-20
1	**Project Kick-Off**	◆											
	Deliverable 1: Kick-Off Meeting												
2	**Project Management**			▒			▒			▒			▒
	Deliverable 2: Quarterly Progress Reports			◆			◆			◆			◆
3	**Needs Assessment & Data Analysis**				█	█	█	█					
	Deliverable 3: Technical Memo/Needs & Requirements							◆					
4	**Emerging Data Collection Technologies**								█	█			
	Deliverable 4: Technical Memo/Recommendations for New Technologies									◆			
5	**Draft Final Report**									▒	█		
	Deliverable 5: Project Draft Final Report											◆	
6	**Final Report & Workshop**												█
	Deliverable 6: Project Final Report & Workshop to Caltrans Staff												◆

HPMS: Study Objectives

BACKGROUND

- For past 10 years or so, Caltrans has not been collecting data on local roadways (FC=7) due to lack of resources. Caltrans is still required to report the VMT for these local roadways to FHWA in a summary table format.

- One of Caltrans main concerns regarding HPMS data collection and reporting is the lack of traffic data on 119,142 miles of (FC=7) roadways.

STUDY OBJECTIVE:

- Provide a data collection implementation plan that contains data collection methods, data collection cycles, sampling site selection and estimated costs for (FC=7) roadways in California.

"On-System" Miles of Public Roadways in California (2018)

Area Type	Interstate FC = 1 (miles)	Principal Arterial (Freeway or Expressway) FC = 2 (miles)	Principal Arterial (Other) FC = 3 (miles)	Minor Arterial FC = 4 (miles)	Major Collector FC = 5 (miles)	Minor Collector FC = 6 (miles)	Local FC = 7 (miles)	2018 Total Distance (miles)
Rural	1,186	369	3,070	4,891	743	-	-	10,259
Urban	1,270	1,549	1,382	563	69	-	-	4,833
Total	2,456	1,918	4,452	5,454	812	-	-	15,091

Source: Caltrans, HQ Division of Research, Innovation & System Information (November 4, 2019 email)

"Off-System" Miles of Public Roadways in California (2018)

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Rural	-	-	194	1,249	11,289	7,487	40,797	61,016
Urban	-	1	5,313	10,398	12,544	368	70,858	99,482
Total	-	1	5,508	11,646	23,833	7,854	111,655	160,498

Source: Caltrans, HQ Division of Research, Innovation & System Information (November 4, 2019 email)
Note: Red shaded cells (FC= 6 [Rural] and FC=7).

HPMS software provides randomly selected count locations for:

Urban and Small Urban areas:

- Interstate (FC=1)
- Principal Arterial (FC=2 and FC=3)
- Minor Arterial (FC=4)
- Major Collector (FC=5)
- Minor Collector (FC=6)

No FC=7 for Small Urban

Rural areas:

- Interstate (FC=1)
- Principal Arterial (FC=2 and FC=3)
- Minor Arterial (FC=4)
- Major Collector (FC=5)

No FC=6 or FC=7 for Rural

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HPMS Samples

The size of HPMS samples are based on three components:

1. Variability (coefficient of variance of AADT)
2. Functional system confidence interval and precision level
3. Number of TOPS sections in a volume group

Sample-size estimation formula: $n = \dfrac{\left(\dfrac{z^2 c^2}{d^2}\right)}{1+\left(\dfrac{1}{N}\right)\left(\left(\dfrac{z^2 c^2}{d^2}\right)-1\right)}$

Where:

n = Required sample size

Z = Standard normal statistic for an alpha confidence level (two-sided)

C = AADT coefficient of variation from State's AADT data

d = Desired precision rate (from HPMS Table 6.2)

N = Number TOPS sections available for sampling in a volume group

Required (New) Samples by Caltrans District and Roadway Functional Classification Type

Caltrans District	Urbanized Area and Roadway Functional Classification Types				
	Urban	Small Urban	Rural	Rural	All Facility Types
	Local (FC=7)	Local (FC=7)	Minor Collector (FC=6)	Local (FC=7)	
1	-	7	4	5	16
2	1	2	13	15	31
3	6	14	13	12	45
4	14	3	4	3	24
5	-	4	5	4	13
6	4	21	14	19	58
7	25	1	3	1	30
8	12	10	2	7	31
9	0	1	2	3	6
10	4	5	10	10	29
11	7	1	7	5	20
12	1	-	-	-	1
CA-Statewide	74	69	77	84	304

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HPMS Segment Selection Process Repeated for FC=6 and FC=7 Roadways

- Random locations (segments) were selected using the Caltrans Linear Referencing System (LRS) shapefile for Off-System roadways.

- The random location selection process was weighted by Caltrans LRS segment lengths, to create an unbiased selection process.

- With that, a two-mile roadway segment was four times more likely to be selected than a half-mile roadway segment.

- Randomly generated count locations in final report's Appendix A

Count Schedule and Budget

Count Cycle (Year)	Caltrans Districts	Number of Counts
Year-1	1, 2	47
Year-2	3	45
Year-3	4, 5, 9	43
Year-4	8, 10	60
Year-5	7, 11, 12	51
Year-6	6	58
CA-Statewide	Total	304

Number of Lanes	Class / Non-Class	Current Bid Rate
1 to 2	Class	$75.00
3 to 4	Class	$325.00
5 to 6	Class	$550.00
7 to 8	Class	$925.00
1 to 2	Non-Class	$55.00
3 to 4	Non-Class	$80.00
5 to 6	Non-Class	$105.00
7 to 8	Non-Class	$125.00

For roadways that are not on the State Highway System, the Caltrans Traffic Count Guidelines states:

"It is recommended that two-thirds of the HPMS counts be volume counts, and that one-third be classification counts."

Annual costs: approximately $3,145

- 304 additional count stations,
- 6-year count cycle,
- 1/3 classification counts

HPMS Sample Adequacy & Maintenance

Number of 2018 TOPS Samples
Outside HPMS Recommended Section Length Ranges

HPMS Field Manual Recommended TOPS Section Quality Check	Number of Caltrans 2018 TOPS Samples Exceeding Threshold
Rural Sections (Urban Code=99999) with length < 0.3 miles	121 (16.3%)
Rural Sections (Urban Code=99999) with length > 10.0 miles	5 (0.7%)
Urban Access Controlled Facility Sections (FC=1 or FC=2) with length > 5.0 miles	3 (0.3%)
Other Urban Sections (FC=3 through FC=6) with length < 0.1 mile	3,356 (40.9%)
Other Urban Sections (FC=3 through FC=6) with length > 3.0 miles	67 (0.8%)

HPMS Sample Adequacy & Maintenance

Count of 2018 TOPS Samples with Expansion Factor > 100

Urban Code	Interstate FC = 1	Principal Arterial (Freeway or Expressway) FC = 2	Principal Arterial (Other) FC = 3	Minor Arterial FC = 4	Major Collector FC = 5	Minor Collector FC = 6	Local FC = 7	All Facility Types
4681	-	-	8	-	11	-	n/a	19
33328	-	-	3	-	-	-	n/a	3
50527	-	-	3	-	-	-	n/a	3
51445	3	-	24	48	50	-	n/a	125
66673	-	-	3	-	-	-	n/a	3
73774	-	-	-	3	7	-	n/a	10
75340	-	-	3	5	8	-	n/a	16
77068	-	-	17	-	-	-	n/a	17
78310	-	-	-	-	3	-	n/a	3
78661	3	-	-	5	28	-	n/a	36
78904	-	-	23	19	44	-	n/a	86
79039	-	-	18	19	7	-	n/a	44
79309	-	-	6	-	-	-	n/a	6
79417	-	-	-	-	3	-	n/a	3
99998	-	-	-	21	38	-	n/a	59
99999	-	-	-	21	53	n/a	n/a	74
State Wide	**6**	**0**	**108**	**141**	**252**	**0**	**n/a**	**507**

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HPMS: Recommendations

Add the 304 newly identified FC=6 & FC=7 count stations to the HPMS count locations.

Many of the TOPS samples with an expansion factor > 100 are shorter than the HPMS recommended section length.

- These should be reviewed by Caltrans to determine if the section lengths can be increased or if (longer) adjacent sections could serve as HPMS TOPS samples in lieu of these short sample sections.

Currently Caltrans does not have any year-round count stations on the off-system SHWY roadway sections (for developing seasonal correction factors).

- Caltrans should select a small subset of the off-system count locations in each District and install year-round count stations at these locations.

Census: Study Objectives

Background:

- **Currently, Caltrans Districts (and the Census Program) only nominally leverage PeMS data for meeting their annual traffic count obligations.**

- **Caltrans PeMS system archives traffic data from thousands of permanent vehicle detector stations in Districts 3, 4, 5, 6, 7, 8, 10, 11, and 12 (all but rural Districts 1, 2 and 9).**

Study Objective:

- **Explore the feasibility of more effectively utilizing PeMS data for fulfilling the annual Census count obligations.**

Number of 2019 Mainline Census Stations and Matching PeMS Stations

Caltrans District	Number of Mainline Census Stations (FWY, EXP or CON)	Number of Matching Mainline PeMS Stations			Number of Matching Mainline PeMS Stations with Matching Number of Lanes			Average Distance between Census & PeMS Stations (miles)	
		Primary Direction	Secondary Direction	Both Directions	Primary Direction	Secondary Direction	Both Directions	Primary Direction	Secondary Direction
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	383	79	87	79	11	15	11	0.10	0.12
4	371	175	165	165	45	46	45	0.14	0.13
5	144	26	23	23	6	3	3	0.13	0.15
6	365	85	88	85	8	7	7	0.17	0.17
7	306	181	181	181	34	31	31	0.16	0.16
8	236	75	72	72	22	20	20	0.15	0.14
9	-	-	-	-	-	-	-	-	-
10	214	46	46	46	8	13	8	0.13	0.12
11	253	104	110	104	7	16	7	0.14	0.15
12	100	68	67	67	38	32	32	0.12	0.11
CA Statewide	2,372	839	839	822	179	183	164	0.14	0.14

Source: Census Count Locations: Caltrans – Traffic Census Program
PeMS Station Locations: Caltrans – PeMS
Census-To-PeMS Matching: U.C. Berkeley ITS/PATH

Census: Recommendations

For the 164 matching PeMS-Census locations (with lane match):

- Evaluate how well the Census reported AADTs match the PeMS estimated AADTs to identify if PeMS is a suitable data source for Caltrans Census needs.

For the 658 PeMS-Census locations (without lane match):
- Ascertain whether factored PeMS volumes might be useful, or maybe useful for seasonality trends (monthly adjustment factors, etc.)

Emerging Technologies: Study Objectives

Background:

- Numerous transportation data providers collect all kinds of information generated from global positioning system, Bluetooth, their own subscribers, and supplemental data these providers acquire from location-based service providers.

- The reliability and validation statistics of their resulting traffic performance metrics (including their AADT estimates) has been improving significantly over time.

Study Objective:

- Review and evaluate the commercially available volume data as an alternate to manually collected AADTs.

Emerging Technologies – Current Status

Availability and quality of traffic count data from commercial vendors continually increasing over time; with prices dropping. And more data validation reports are being published.

Currently, multiple competing commercial vendors:

- CITILABS Streetlytics

- INRIX Volume Profiles

- STREETLIGHT InSights

Use of commercial count data is quickly becoming more accepted. COVID-19 pandemic accelerated use and acceptability of "big-data" traffic count estimates.

Emerging Technologies – Current Status

Currently, StreetLight Data is engaged with FHWA on a validation study for Big-Data as an alternate means for HPMS reporting.

- Project Number: 693JJ319C000015
- Project Title: Non-Traditional Methods to Obtain Annual Average Daily Traffic (AADT) Evaluation and Analysis"

At least one state DOT (Minnesota) is using StreetLight Data under the alternate methods provision currently allowed by FHWA for reporting performance metrics.

Emerging Technologies: Recommendations

Commercial big-data has become a viable data source for HPMS/Census reporting purposes.

Commercial big-data will become even more of a pragmatic (cost-efficient and appropriate) choice as the reliability and public acceptance continue to improve.

- Use PeMS where possible – to fulfill HPMS/Census traffic volume requirements

- Conduct a pilot study – using commercial big-data to fulfill HPMS/Census traffic volume requirements

Questions / Comments

Thank You!