Calibration Workshop for US101 VISSIM Model

presented to

Caltrans D5

presented by

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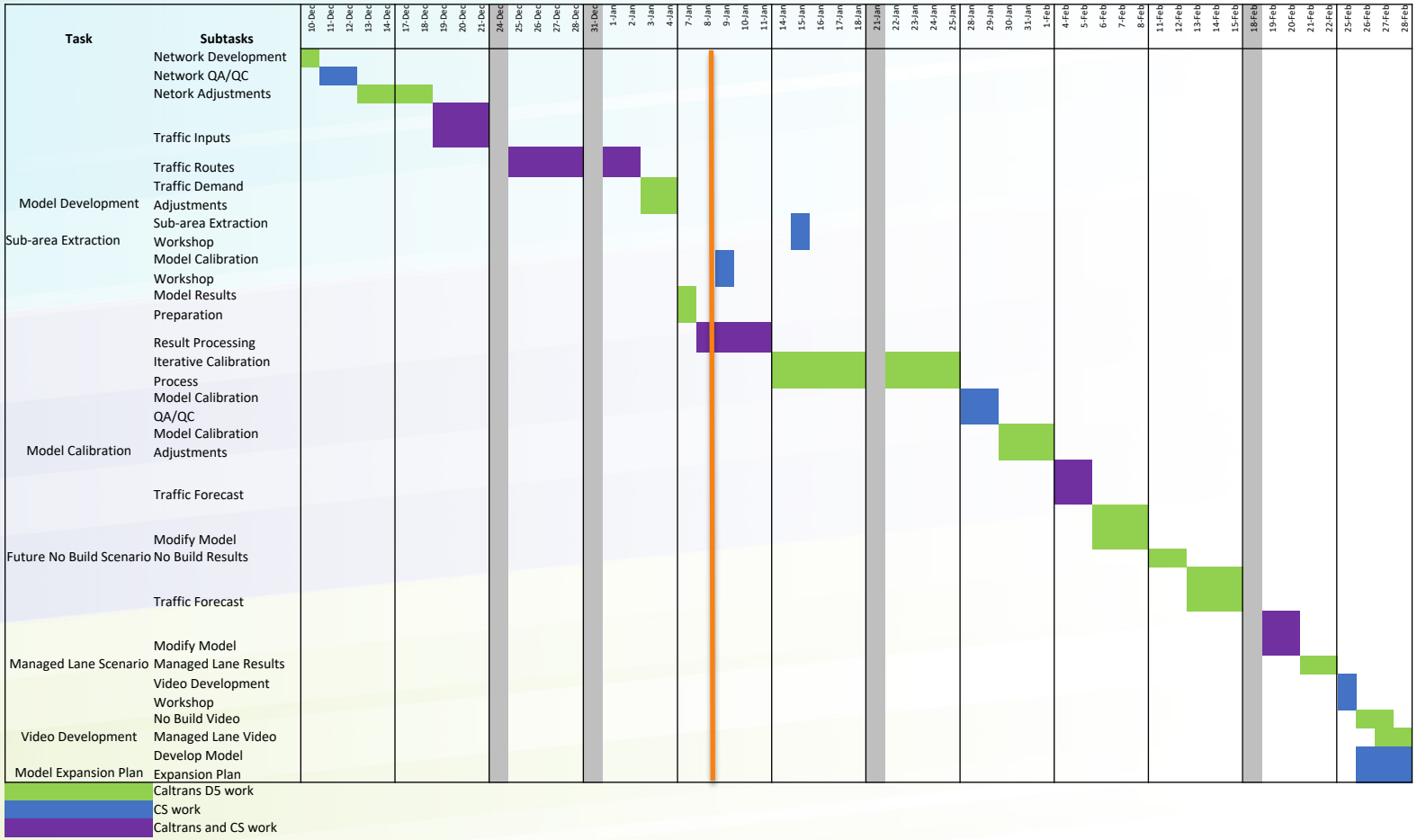
Think Forward

January, 2019

Agenda

- Review Project Schedule
- Define Workshop Objectives
- What is Calibration?
- Define Calibration Criteria
- Define Calibration Process
- Discuss Examples of Calibration Results
- Discuss Project's Next Steps

Project Schedule



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Workshop Objectives

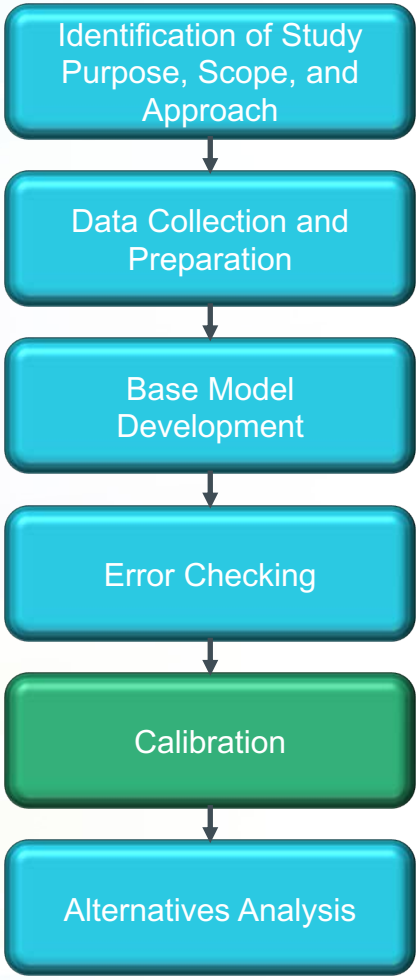
- Understand what is calibration for traffic simulation models.
- Define the criteria to be used to calibrate the model.
- Define a process to follow to calibrate the US-101 simulation model.

What is Calibration?

- The process to determine whether the simulation model results are close enough to represent the actual system.
- Calibration is usually achieved through an iterative process involving the modification of the model's parameters and the comparison of the modeled results to actual observed system behavior. The discrepancies between the two, and the insights gained, are then used to improve the model until the accuracy is judged to be acceptable.

Calibration in Traffic Simulation

- In traffic simulation, the calibration process is an essential part of the model development process.
- The calibration process gives analysts and decision makers the confidence to use the simulation model for analysis.
- The result from this process is a version of the model that satisfies the calibration criteria, and can be used for scenario testing.



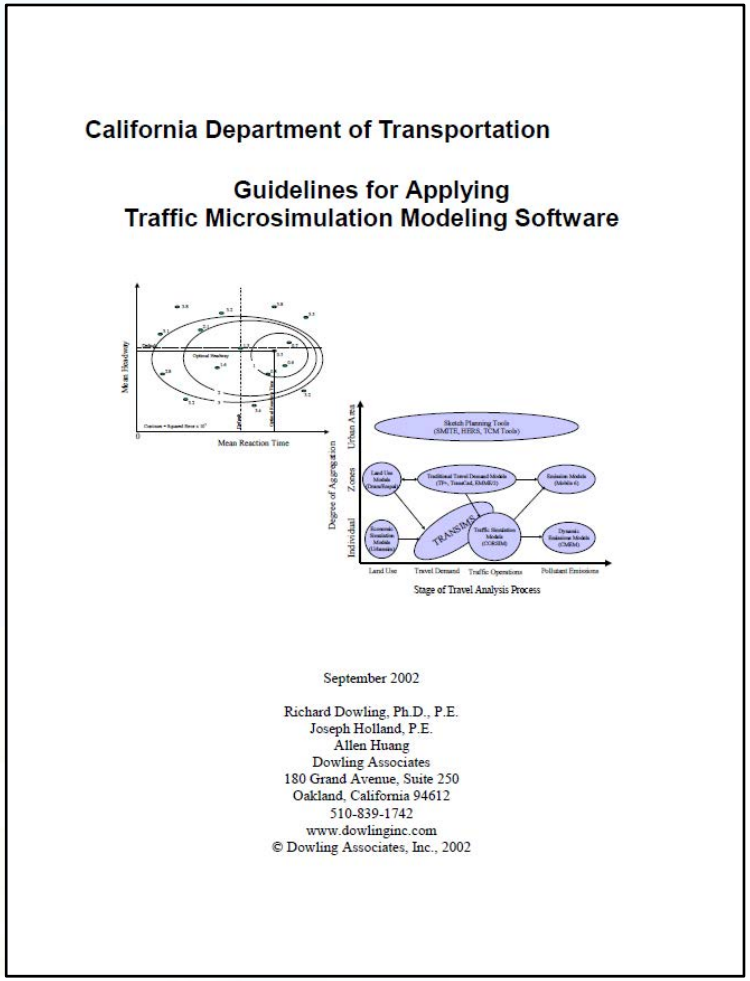
Source: Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software

Calibration Guidelines (1)

- There are several guidelines to help practitioners define calibration metrics and targets.
  - FHWA's "Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software".
  - Guidelines for Applying Traffic Microsimulation Modeling Software, Caltrans (2002).
  - Transport for London "Traffic Modeling Guidelines".
  - Among others

Calibration Guidelines (2)

- New FHWA Volume III Update Report is completed, but not yet published. Publication date still TBD.
- Workshops introducing this new methodology to Caltrans took place in July 2018, in LA.
- For this project, the Calibration Guidelines prepared for Caltrans will be used.



California Department of Transportation

Guidelines for Applying
Traffic Microsimulation Modeling Software

September 2002

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Joseph Holland, P.E.
Allen Huang
Dowling Associates
180 Grand Avenue, Suite 250
Oakland, California 94612
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www.dowlinginc.com

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Calibration Criteria

- FHWA and Caltrans current criteria (2002)
- For this project, calibration will focus on volumes and speeds:

Criteria and Measures	Acceptability Target
Traffic Volumes, Model versus Observed	
Individual Link Flows:	
Within 15%, for 700 vph < Flow < 2700 vph	> 85% of cases
Within 100 vph, for Flow < 700 vph	> 85% of cases
Within 400 vph, for Flow > 2700 vph	> 85% of cases
GEH < 5	> 85% of cases
Speed and Congestion Profiles, Visual Audits	
Individual Link Speeds:	
Visually acceptable Speed-Flow relationships	To analyst's satisfaction
Bottlenecks:	
Visually acceptable queuing	To analyst's satisfaction

Volume Calibration Criteria

- Based on the FREQ count analysis, the counts taken on Thursday April 19th are slightly lower than PeMS counts.
- Suggest using FREQ balanced counts to start with, but calibrate to PeMS speeds and counts.

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Calibration Process

- Review Basic Network Elements
- Pre-Calibration Error Checking
- Establish calibration objectives
- Identify the performance measures and critical locations against which the models will be calibrated.
- Determine the statistical methodology to be used to compare modeled results to the field data.
- Determine the strategy for model calibration and identify parameters that are the focus of adjustments.
- Assemble field data previously collected for comparison to model outputs
- Conduct model calibration runs following the strategy and conduct statistical checks.
- Validation: Test or compare the calibrated model with a data set not used for calibration

Model Calibration

- Three Main Calibration Processes:
  - Traffic Network Calibration
  - Route Choice Calibration
  - Demand Calibration
- Ideally in that order. In reality is an iterative process

Network Calibration Parameters

- Network Representation
  - Accurately represented
    - Posted speeds, lane channelization, grades, visibility, speeds on curves, etc.
- Driver Behavior
  - Car following parameters, lane changing parameters, desired speed distributions, etc.
- Controls
  - Driver reaction to signals / stop controls
  - Gap acceptance model parameters

Route Choice Parameters

- Static Routes:
  - Defining routes for entire origins and destinations
  - Aggregating trips and compare to volumes
  - Adjusting routes to match volumes
- Dynamic Routes:
  - Cost functions
  - User costs
  - Vehicle type restrictions
  - DTA use and settings
  - Value of time / Willingness to pay

Demand Calibration

- Initial OD source / estimation
- OD Matrix Estimation (ODME) process (if used)
  - Static
  - Dynamic
- Define model inputs to consider the difference between throughput and volume. This could result in demand shifting.

Calibration Parameter Checks

- Use of heavy local adjustments is not good calibration practice
  - Some are inevitable
- Global and/or roadtype adjustments are preferred
  - Or rules based application of parameter changes
- Adjusting too many parameters is not good practice
  - Adjust key parameters the modeler has confidence in
- Avoid overfitting of model to field data
- Are enough random seed runs being performed?
  - Statistical significance of results

Example Volume Calibration Results (1)

- Model and data collection volumes are processed and compared using the GEH statistic:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

M – Modeled volumes
C – Count Volumes

Example Volume Calibration Results (2)

		Count - All Vehicles							Simulated - All Vehicles							GEH						
Name	Type	6:00	7:00	8:00	9:00	10:00	11:00	Avg Flow	6:00	7:00	8:00	9:00	10:00	11:00	Avg Flow	6:00	7:00	8:00	9:00	10:00	11:00	Avg Flow
ORANGETHORPE	ML	5105	5676	5946	5679	5402	5351	5526.5	5542.9	6053.6	6180.3	5946.9	5317.2	5179.5	5703.4	6.00	4.93	3.01	3.51	1.16	2.36	2.36
CARMENITA	ML	4935	5456	5426	5269	5152	5121	5226.5	5206	5758.4	5674.6	5553.2	4999.4	4956.8	5358.066667	3.81	4.04	3.34	3.86	2.14	2.31	1.81
183RD	ML	5229	5757	5770	5579	5445	5406	5531.0	5578.4	6035.5	6055.9	6045.5	5499.6	5412.3	5771.2	4.75	3.63	3.72	6.12	0.74	0.09	3.20
ARTESIA	ML	5038	5344	5227	4847	5017	5126	5099.8	5334.5	5529.9	5461.3	5313	5052.6	5112.7	5300.666667	4.12	2.52	3.21	6.54	0.50	0.19	2.78
BLOOMFIELD	ML	5441	5807	5761	5328	5470	5587	5565.7	5703.4	5870.6	5973.3	5794.7	5549.7	5659.9	5758.6	3.52	0.83	2.77	6.26	1.07	0.97	2.56
Bloomfield/Norwalk	ML	5754	6163	6137	5620	5779	5959	5902.0	6028	6200.1	6375.6	6123.1	5899.1	6075.1	6116.833333	3.57	0.47	3.02	6.57	1.57	1.50	2.77
NORWALK 2	ML	5668	6010	5858	5374	5588	5745	5707.2	5815	5900.6	6049.3	5748	5589.4	5733.5	5805.966667	1.94	1.42	2.48	5.02	0.02	0.15	1.30
NORWALK 1	ML	5864	6266	6224	5745	5909	6029	6006.2	6006.5	6139.2	6224.4	6033.5	5967.7	6075.5	6074.466667	1.85	1.61	0.01	3.76	0.76	0.60	0.88
Norwalk/Pioneer	ML	6040	6498	6532	5998	6161	6222	6241.8	6143.6	6314.3	6544.1	6344.3	6255	6283.5	6314.133333	1.33	2.30	0.15	4.41	1.19	0.78	0.91
PIONEER 2	ML	7140	7394	7386	6866	6904	6721	7068.5	6969.6	7224.8	7310.9	7039.7	6836.7	6674.1	7009.3	2.03	1.98	0.88	2.08	0.81	0.57	0.71
PIONEER 1	ML	6073	6340	6481	6006	6168	6325	6232.2	6043.1	6268.2	6496.5	6434.3	6312.8	6487.6	6340.416667	0.38	0.90	0.19	5.43	1.83	2.03	1.37
Gridley	ML	6325	6647	6858	6394	6480	6595	6549.8	6346.6	6560.5	7007.5	6976.1	6757.9	6877.9	6754.416667	0.27	1.06	1.80	7.12	3.42	3.45	2.51
FF to Studebaker	ML	4006	3831	3836	3441	3724	3856	3782.3	3956.2	3755.3	4064.2	3906.7	4084.5	4454.1	4036.833333	0.79	1.23	3.63	7.68	5.77	9.28	4.07
STUDEBAKER	ML	3909	3649	3436	3117	3481	3594	3531.0	3723	3581.2	3707.4	3632	3763.9	4113.3	3753.466667	3.01	1.13	4.54	8.87	4.70	8.37	3.69
W OF 605	ML	4583	4433	4326	3970	4421	4528	4376.8	4344.8	4381.3	4640.3	4504.6	4700	5079.5	4608.416667	3.57	0.78	4.69	8.21	4.13	7.96	3.46
CALIFORNIA	ML	6173	6053	6126	5400	6081	6288	6020.2	5704.7	5619.7	6026.9	5499.6	5680.5	6821.9	5892.216667	6.08	5.67	1.27	1.35	5.22	6.59	1.66
ORANGETHORPE	HOV	1193	1048	1059	1086	961	759	1017.7	1175.8	1200.4	1167.7	1093.3	1081.2	976.4	1115.8	0.50	4.55	3.26	0.22	3.76	7.38	3.00
CARMENITA	HOV	1193	1048	1059	1086	961	759	1017.7	1240.1	1253.1	1143	1070.7	1080	941.5	1121.4	1.35	6.05	2.53	0.47	3.73	6.26	3.17
183RD	HOV	1193	1048	1059	1086	961	759	1017.7	1232.9	1251.9	1144.1	1073.1	1078.3	941.5	1120.3	1.15	6.01	2.56	0.39	3.67	6.26	3.14
ARTESIA	HOV	1193	1048	1059	1086	961	759	1017.7	1220.5	1256.3	1143.3	1073.5	1078.5	943.9	1119.333333	0.79	6.14	2.54	0.38	3.68	6.34	3.11
BLOOMFIELD	HOV	1193	1048	1059	1086	961	759	1017.7	1210.9	1258.4	1143.1	1072.7	1079.7	945.3	1118.35	0.52	6.20	2.53	0.40	3.72	6.38	3.08
Bloomfield/Norwalk	HOV	1193	1048	1059	1086	961	759	1017.7	1207.6	1261	1140.9	1073.3	1079.2	946.3	1118.05	0.42	6.27	2.47	0.39	3.70	6.41	3.07
NORWALK 2	HOV	1193	1048	1059	1086	961	759	1017.7	1202.2	1262.8	1141.2	1072.7	1078.8	947.5	1117.533333	0.27	6.32	2.48	0.40	3.69	6.45	3.06
NORWALK 1	HOV	1193	1048	1059	1086	961	759	1017.7	1199.2	1262.4	1141.1	1074.8	1077.6	947.4	1117.083333	0.18	6.31	2.48	0.34	3.65	6.45	3.04
Norwalk/Pioneer	HOV	1193	1048	1059	1086	961	759	1017.7	1197.3	1259.8	1142.1	1073.9	1079.8	945.8	1116.45	0.12	6.24	2.50	0.37	3.72	6.40	3.02
PIONEER 1	HOV	1207	1228	1133	1104	1017	686	1062.5	1191.3	1179	1095.4	855.2	901.2	586.4	968.0833333	0.45	1.41	1.13	7.95	3.74	3.95	2.96
Gridley	HOV	1207	1228	1133	1104	1017	686	1062.5	1185.3	1179.9	1095	856.6	901.5	588.5	967.8	0.63	1.39	1.14	7.90	3.73	3.86	2.97
FF to Studebaker	HOV	1207	1228	1133	1104	1017	686	1062.5	1179	1180.6	1096.7	854.5	903.3	588.9	967.1666667	0.81	1.37	1.09	7.97	3.67	3.85	2.99
STUDEBAKER	HOV	1207	1228	1133	1104	1017	686	1062.5	1175.5	1179.8	1098.6	853.9	904.3	588.7	966.8	0.91	1.39	1.03	7.99	3.64	3.85	3.00
W OF 605	HOV	1207	1228	1133	1104	1017	686	1062.5	1165.9	1179.9	1100.3	855	903.7	592.6	966.2333333	1.19	1.39	0.98	7.96	3.66	3.69	3.02
CARMENITA	OFF	170	220	520	410	250	230	300.0	170.7	194.8	445.5	475.1	324.5	304.9	319.25	0.05	1.75	3.39	3.09	4.40	4.58	1.09
183RD	ON	293	300	344	310	292	284	303.8	405.5	318.8	442.6	463.5	486.8	413.1	421.7166667	6.02	1.07	4.97	7.81	9.87	6.92	6.19
SHOWMAKER	OFF	190	412	543	732	427	279	430.5	201.2	398.8	562.4	761.4	489.6	335.5	458.15	0.80	0.66	0.83	1.08	2.92	3.22	1.31
ARTESIA	ON	403	462	534	481	453	461	465.7	415.2	477	503.7	493.7	456.7	516.8	477.1833333	0.60	0.69	1.33	0.58	0.17	2.52	0.53
BLOOMFIELD	ON	312	356	375	292	309	372	336.0	333.2	360.9	395.5	324.9	339.6	405	359.85	1.18	0.26	1.04	1.87	1.70	1.67	1.28
NORWALK NB	OFF	85	153	279	246	191	214	194.7	179.5	204.5	347.2	358.5	328	334.2	291.9833333	8.22	3.85	3.85	6.47	8.50	7.26	6.24
NORWALK NB	ON	196	256	366	370	321	283	298.7	220.8	280.4	160.4	295	367.5	341.5	277.6	1.72	1.49	12.67	4.11	2.51	3.31	1.24
NORWALK SB	ON	175	232	307	253	252	193	235.3	169.5	196.8	306.9	314.9	278.9	205.1	245.35	0.42	2.40	0.01	3.67	1.65	0.86	0.65
PIONEER 2	OFF	93	152	204	217	218	260	190.7	326	347	398.4	397.1	524.6	593.8	431.15	16.10	12.35	11.20	10.28	15.91	16.16	13.64
PIONEER NB	ON	141	175	227	243	281	290	226.2	325.5	248.4	287.8	279.7	396.2	433.5	328.5166667	12.08	5.04	3.79	2.27	6.26	7.54	6.15
PIONEER SB	ON	251	306	377	388	311	269	317.0	343.6	336.1	470.4	557.4	432.3	398.3	423.0166667	5.37	1.68	4.54	7.79	6.29	7.08	5.51
WB 91 TO NB 605	OFF	1884	2095	2031	2003	1971	1904	1981.3	1910.2	2103.4	2040.4	2001.1	1945	1602.3	1933.733333	0.60	0.18	0.21	0.04	0.59	7.21	1.08
WB 91 TO SB 605	OFF	434	721	991	949	784	834	785.5	387.3	621.3	985.6	1014.7	826.9	824.6	776.7333333	2.30	3.85	0.17	2.10	1.51	0.33	0.31
STUDEBAKER	OFF	97	181	399	324	243	262	251.0	220.9	169.9	345.9	272.4	314.4	336.3	276.6333333	9.83	0.84	2.75	2.99	4.28	4.30	1.58
NB 605 to SR91 WB	ON	674	784	889	853	940	934	845.7	657.6	785.7	921.9	860.6	948	954.1	854.65	0.64	0.06	1.09	0.26	0.26	0.65	0.31
SB 605 TO WB 91	ON	1590	1620	1800	1430	1660	1760	1643.3	1503.9	1549.5	1682.6	1222.4	1509.5	1747.5	1535.9	2.19	1.77	2.81	5.70	3.78	0.30	2.69

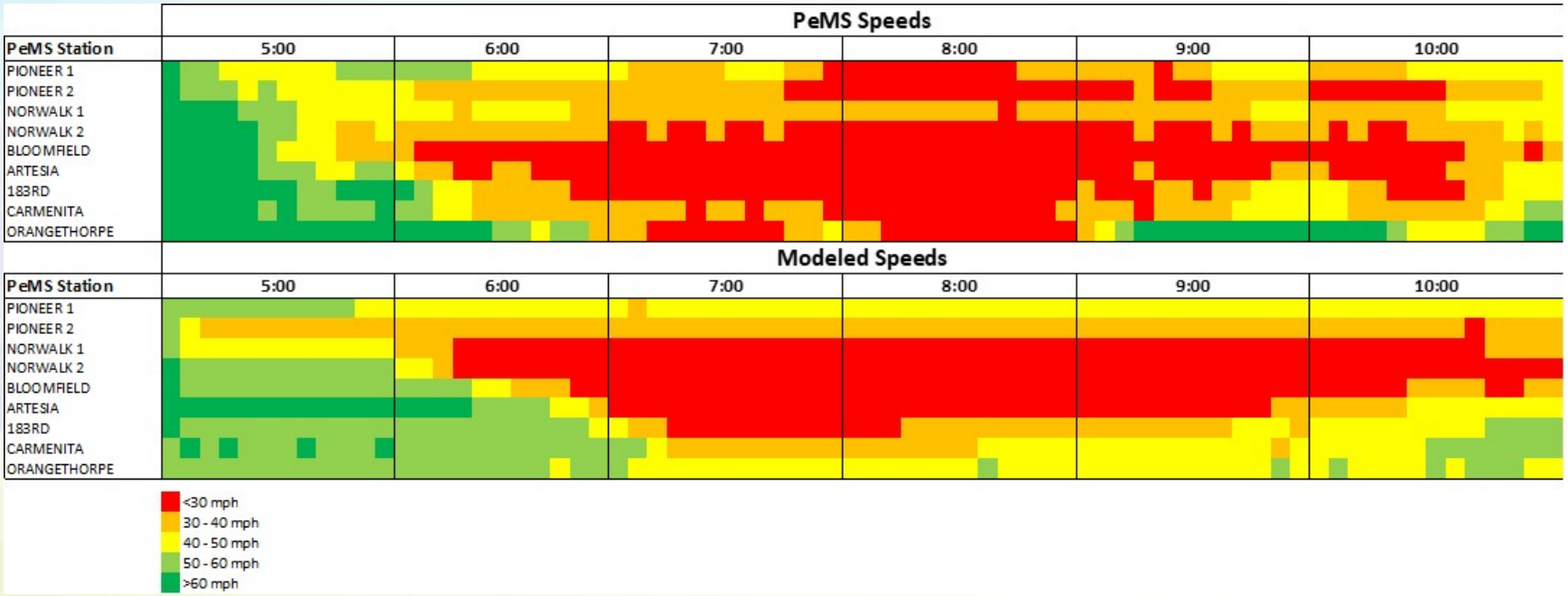
Example Volume Calibration Results

- Calculate percentage of data points passing calibration criteria
- If percentage is over 85%, model volumes meet calibration criteria.

Calibration Criteria	5 – 6 AM	6 – 7 AM	7 – 8 AM	8 – 9 AM	9 – 10 AM	10 – 11 AM	Average flow
% of Mainline counts with GEH<5.0	94%	94%	100%	50%	81%	75%	100%
% of Mainline counts within 400 veh difference, for Flow > 2700 vph	100%	88%	100%	75%	100%	75%	100%
% of Mainline counts within 15% difference, for 700 vph < Flow < 2700 vph	n/a	n/a	n/a	n/a	n/a	n/a	n/a
% of Mainline counts within 400 veh difference, for Flow < 700 vph	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Example Speed Calibration Results

- Modeled and real speeds are compared to represent the modeled bottleneck formation, duration, and length.



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NEXT STEPS

Model Calibration

- Model Calibration
- Review detectors to obtain speeds and volumes from the model.
- Generate a spreadsheet to process model results and compute calibration parameters.
- Modify model parameters for calibration.
- Review calibration

Future "No-Build" Scenario

- Define future traffic growth rates and potential future demand changes. Information from the SLOCOG model may be consulted.
- Apply future demand changes on calibrated model.
- Run "No-Build" Scenario and obtain results

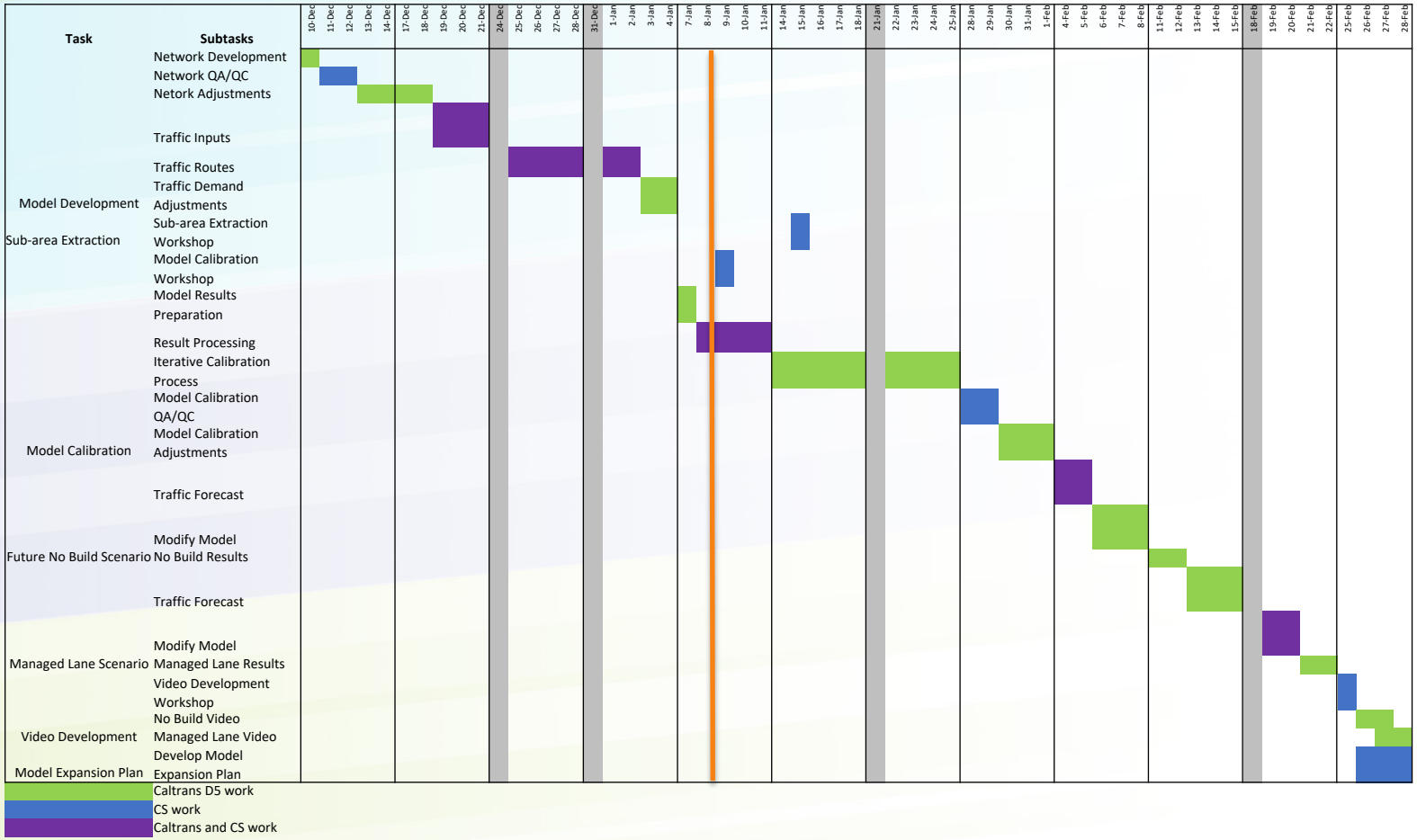
Managed Lane Scenario

- Define Managed Lane geometry and operation in the model based on project design schematics.
- Define traffic growth rates and managed lane demand. Information from the SLOCOG model may be consulted.
- Apply future demand changes on calibrated model.
- Run “Managed Lane” Scenario and obtain results

Video Development and Next Steps

- Workshop on Vissim video development best practices.
- Record video for “No-Build” Scenario.
- Record video for “Managed Lane” Scenario.
- Discuss potential to expand model across the project’s region to be used

Project Schedule



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SMALL BREAK

NEXT: DISCUSS STATE OF MODEL AND ANALYSIS