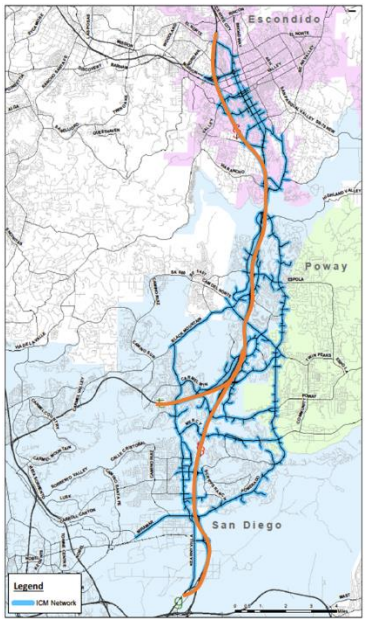
Analysis, Modeling, and Simulation (AMS) Testbed Development and Evaluation to Support Dynamic Mobility Applications (DMA) and Active Transportation and Demand Management (ATDM) Programs

Calibration Report – San Diego



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16. Abstract

The primary objective of this project is to develop multiple simulation Testbeds/transportation models to evaluate the impacts of DMA connected vehicle applications and the active and dynamic transportation management (ATDM) strategies. The outputs (modeling results) from this project will help USDOT prioritize their investment decisions for DMA and ATDM programs.

The primary purpose of this report is to document the calibration process for AMS ICM San Diego Testbed. The report expands on detailed testbed description including the geographic location, modes, operational conditions and cluster analysis details. The report discusses the field observed data used to calibrate the simulation models. Listed in this report are also the margin of error for each calibration effort for the typical day and each baseline model.

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Chapter 1. Introduction

The United States Department of Transportation (USDOT) initiated the Active Transportation and Demand Management (ATDM) and the Dynamic Mobility Applications (DMA) programs to achieve transformative mobility, safety, and environmental benefits through enhanced, performance-driven operational practices in surface transportation systems management. In order to explore a potential transformation in the transportation system's performance, both programs require an Analysis, Modeling, and Simulation (AMS) capability. Capable, reliable AMS Testbeds provide valuable mechanisms to address this shared need by providing a laboratory to refine and integrate research concepts in virtual computer-based simulation environments prior to field deployments.

The foundational work conducted for the DMA and ATDM programs revealed a number of technical risks associated with developing an AMS Testbed which can facilitate detailed evaluation of the DMA and ATDM concepts. Therefore, instead of selecting a single Testbed, it is desirable to identify a portfolio of AMS Testbeds and mitigate the risks posed by a single Testbed approach by conducting the analysis using more than an "optimal" number of Testbeds, reduces the resources available to enhance or improve the Testbeds to address the gaps. At the conclusion of the AMS Testbed selection process, four (4) AMS Testbeds were initially selected to form a diversified portfolio to achieve rigorous DMA bundle and ATDM strategy evaluation: San Mateo (US 101), Pasadena, ICM Dallas and Phoenix Testbeds. In addition, the AMS Testbed Team added ICM San Diego Testbed and the Chicago Testbed to the selected Testbeds to be able to cover the overall scope of the project and to further the research answers of the project. The analysis plan describes the overall approach for modeling and evaluating the impacts of DMA bundles and ATDM strategies. In addition, the analysis plan helps to test the hypotheses of the DMA and ATDM Programs and evaluate the implementation's costs of their applications.

The primary purpose of this report is to document the analysis plan approach for the San Diego Testbed. The San Diego Testbed facility comprises of the interstate I-15 and associated parallel arterials and extends from the interchange with SR 78 in the north to the interchange with Balboa Avenue. It includes the cities of Escondido, Poway, and San Diego. This Testbed will be used to test ATDM strategies including Predictive Traveler Information, Dynamic HOV/Managed Lanes, Dynamic Routing, Dynamic Speed Limits and Dynamic Merge Control as well as DMA application bundles including: INFLO (queue warning, speed harmonization, cooperative adaptive cruise control) and MMITSS bundles. The Testbed will integrate third party software implementing these strategies and applications, with a general data bus to link all systems as well as AIMSUN-based network serving the virtual reality.

This Testbed will be used to test several ATDM strategies and several DMA applications. The ATDM strategies will be tested considering a proactive network management approach that adopts simulation-based prediction capabilities. These strategies include Dynamic Lane Use Control with Dynamic HOV/Managed Lanes, Dynamic Speed Limits, Dynamic Routing, and Dynamic Merge Control, the Intelligent Network Flow Optimization application (INFLO including Q-WARN, SPD-HARM, CACC), and the Multi-Modal Intelligent Traffic Signal System. Testbed is developed using the Aimsun software, which was developed by Transport Simulation Systems.

This report is organized into four chapters as follows:

- Chapter 1 – Introduction: This chapter presents the report overview and objective

- Chapter 2 – Testbed Description: This chapter presents the regional characteristics of the Testbed, the proposed operational conditions, the results of the cluster analysis and the selection of the baseline scenarios.
- Chapter 3 – Model Calibration Methodology: This chapter presents the methodology used to calibrate the Aimsun ICM model, validate it against the operational conditions of the baseline typical day (Tuesday/Thursday average) as well as the scenarios days selected for the Testbed. The methodology describes the process used to adjust the different model parameters.
- Chapter 4 – Calibration Results: This chapter summarizes the model calibration results. It provides a comparison between the operational conditions observed for each scenario and the corresponding model results.

Chapter 2. Testbed Description

This chapter describes the testbed details including its geography, usage and traffic characteristics as well a briefing on the Cluster Analysis that is performed to help in identifying representative operational conditions.

2.1 Testbed Overview

The San Diego Testbed facility comprises of a 22-mile stretch of interstate I-15 and associated parallel arterials and extends from the interchange with SR 78 in the north to the interchange with Balboa Avenue as shown in Figure 2-1. The current I-15 corridor operates with both general-purpose (GP) lanes and four express lanes from the Beethoven Drive DAR to the southern extent of the model. The express lanes are currently under construction from Beethoven Drive to SR-78 and will only be included in the future models. These lanes currently run with two northbound lanes and two southbound lanes and are free to vehicles travelling with two or more passengers in the car (High-Occupancy Vehicles, or HOVs); they also allow Single Occupancy Vehicles (SOV) to use the lanes for a fee, using a variable toll price scheme making them High Occupancy Tolled (HOT) lanes. In addition, it is possible to change the lane configuration of the express lanes with the use of barrier transfer (zipper) vehicles and the Reversible Lane Changing System (RLCS). The entry to the GP lanes is managed during the morning and evening peak hours throughout the corridor by the Ramp Metering Information System (RMIS) that has localized ramp meters running the San Diego Ramp Metering System algorithm. Along the arterials there are two corridors, which are running a Traffic Light Synchronization Program (TLSP) that allows for the use of a more responsive coordinated directional approach to manage the traffic in the peak directions. The TLSP corridors use an algorithm to step through the available timing plans to apply the appropriate plan for the corridor to handle the level of flow.

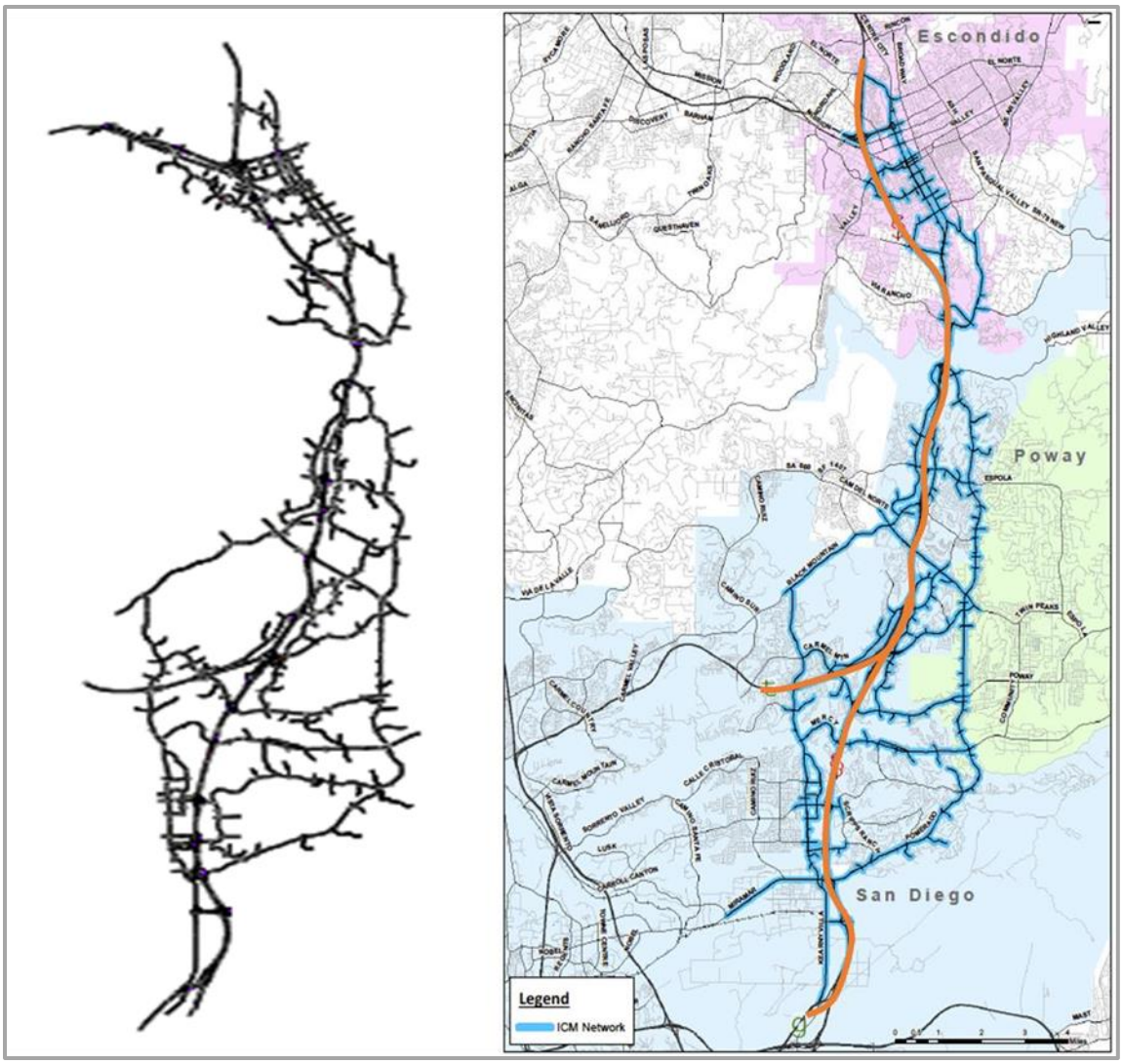

Figure 2-1: The I-15 Corridor in San Diego, California [Source: Aimsun and SANDAG]

For the US 75, the freeway incidents occur at an average frequency of about two incidents per day; resulting in severe congestion especially during the peak periods. In general, the travel time for about 50% of the peak periods is greater than the average travel time recorded during the peak period for the US 75 freeway. This pattern is observed for the northbound and southbound directions. Congestion related to adverse weather conditions has also been observed along the corridor. While such conditions are not frequently encountered, their impact on the overall operational performance of the corridor is significant as drivers are generally not used to driving in such conditions. Based on data collected in 2013, the highest level of congestion is observed along the NB direction in the afternoon peak period with an average speed of about 25 miles per hour. In the morning peak period, congestion is typically observed along the SB direction with an average speed of about 32 miles per hour. The measured daily VMT varies by no more than ±10% from the average value of all days observed. Another important observation is that the morning peak period is generally subjected to more variability in the demand level than the afternoon peak period. The VMT ratio - which is defined as the ration between the VMT recorded for a peak period and the average VMT for all peak periods in the analysis horizon - ranges from 0.2 to 1.4 in the morning peak period, and it ranges from 0.3 to 1.2 in the afternoon peak periods.

Several operation management strategies have been developed for the US 75 corridor as part of the ongoing ICM project. These strategies focus primarily on a) providing real-time multimodal traveler information that allows travelers to better plan their trips using a newly-developed regional 511 system; and b) implementing efficient traffic management schemes (response plans) to mitigate non-recurrent congestion. The real-time simulation-based prediction subsystem, DIRECT, is used to quantify the potential benefits associated with deploying a response plan as recommended by the decision support system.

2.2 Cluster Analysis Results

This subsection describes the cluster analysis that was performed for this testbed.

2.2.1 USDOT ICM Evaluation Team Cluster Analysis

As part of the ICM San Diego Evaluation, Battelle performed a cluster analysis for the post-deployment analysis. Table 2-1 and Table 2-2 summarize the findings of this analysis that was principally focused on analyzing incidents within the corridor. The AM peak hours start at 5 AM and ends at 10 AM. The PM peak hours start at 2 PM and ends at 7 PM.

The variables considered in the cluster analysis are listed below:

- Duration (min): This is the recorded duration of the incident as given in the California Highway Patrol (CHP) records.
- Volume: Average demand in the cluster in vehicles per hour.
- Travel Time: Average recorded end-to-end travel time in minutes for the I-15 freeway.
- Single Incident Delay Impact: This is the difference in the observed travel time versus free-flow travel time and is an indicator of the delay caused by the incident.
- Incidents per Period: Average number of incidents in the analysis period and is computed as the ratio of the total number of incidents to the number of days (or periods).
- Days in Cluster: Represents the days identified to be in the cluster.
- Total Cluster Delay Impact: This is the product of single incident delay impact and days in the cluster.

The final data sets provided were reduced to the AM and PM peak period as the evaluation focused on periods where the ICM system developed and deployed a response plan in reaction to non-reoccurring congestion. As the I-15 corridor is a North/South corridor serving daily commuters to and from downtown San Diego, the data sets provided focused on the AM Southbound and the PM Northbound cluster. Table 2-1 and Table 2-2 show the summary results of the top clusters analyzed from the AM and PM periods. Clusters highlighted in green represent clusters where a representative set of data was provided to the team for a day within the cluster where an incident was present and an ICM response plan was implemented.

Table 2-1: AM Southbound ICM AMS Evaluation Cluster Analysis Summary

Cluster		Duration (min)	Volume (vehicle per hour [vph])	Travel Time (min)	Single Incident Delay Impact (min)	Incidents Per Period	Days in Cluster	Total Cluster Delay Impact (min)
1	SB AM 1	32.64	6,201	15.72	1.72	1.9	29	49.88
2	SB AM 2	42.89	6,348	16.77	2.77	3.7	39	108.03
3	SB AM 3	41.20	6,038	18.33	4.33	5.9	8	34.64
4	SB AM 4	46.01	6,154	16.91	2.91	10.6	5	14.55
5	SB AM 5	804.00	6,314	15.70	1.70	1.0	1	1.70
6	SB AM 6	229.00	6,350	16.52	2.52	1.0	1	2.52
7	SB AM 7	35.44	4,774	15.30	1.30	1.7	3	3.90
8	SB AM 8	32.25	3,417	15.14	1.14	1.5	2	2.28
9	SB AM 9	50.40	5,658	21.81	7.81	9.7	3	23.43

Table 2-2: PM Northbound ICM AMS Evaluation Cluster Analysis Summary

Cluster		Duration (min)	Volume (vehicle per hour [vph])	Travel Time (min)	Single Incident Delay Impact (min)	Incidents Per Period	Days in Cluster	Total Cluster Delay Impact (min)
1	NB PM 1	35.00	6,416	16.04	2.46	2.5	17	41.82
2	NB PM 2	32.53	6,955	16.5	2.92	8.8	8	23.36
3	NB PM 3	46.18	9,034	16.35	2.77	5.5	36	99.72
4	NB PM 4	44.46	8,870	16.11	2.53	2.1	25	63.25
5	NB PM 5	34.71	6,836	19.83	6.25	4.7	3	18.75
6	NB PM 6	38.05	9,156	18.02	4.44	13.0	2	8.88
7	NB PM 7	733.25	7,778	16.45	2.87	4.0	1	2.87
8	NB PM 8	51.29	6,178	24.05	10.47	7.0	1	10.47
9	NB PM 9	189.00	4,620	14.77	1.19	1.0	1	1.19

For the four AM and five PM clusters, nine sets of data were provided. These data sets included the speed and volume detector station data for the following:

- 27 NB HOV Lanes stations: 22 working stations and 5 faulty stations;
- 25 SB HOV Lanes stations: 21 working stations and 4 faulty stations;
- 39 NB General Purpose Lanes stations: 36 working stations and 3 faulty stations;
- 43 SB General Purpose Lanes stations: 39 working stations and 4 faulty stations;
- 77 On/Off Ramp stations;

Although the data was provided for the ramp stations, following a review of the initial data provided, this data was not part of the cluster analysis and is only available for calibration purposes. The full details of

the algorithm and process involved with the cluster analysis that was conducted as part of the ICM AMS evaluation process was performed by Battelle, and a separate report is available for that[1].

2.2.2 Typical Day Cluster Analysis

As part of the ICM system, that is currently running 24 hours a day 7 days a week, 11 different day types or "clusters" were developed to provide the demand matrices and the historical data sets for the ICM prediction models and for the ICM event generation and evaluation process. One primary difference from this cluster analysis and the analysis performed by the Battelle team (in Section 1) is that this analysis was for non-incident conditions. Below are the 11-day types that were identified:

- Type 1 – Monday
- Type 2 – Tuesday and Thursday
- Type 3 – Wednesday
- Type 4 – Friday
- Type 5 – Saturday
- Type 6 – Sunday
- Type 7 – Rainy weekday
- Type 8 – Rainy weekend
- Type 9 –Soft holiday – these are holidays like Columbus Day, which some people treat as a normal working day.
- Type 10 – Hard holiday
- Type 11 – Christmas and Thanksgiving (although hard holidays, these ones have a particularly low demand.)

Mining the historical data and identifying the various trends in the traffic selected these 11 days. These demands were further adjusted to better match the current conditions using detection count data, and running an origin/destination adjustment process in Aimsun. These adjusted demands are the demands that can be used for both the online system and for any offline analysis of the corridor under typical conditions. This demand data and the real-time context data from the available feeds allow for the Aimsun Online model and therefore the offline models to be able to model any conditions.

The data used to develop the trends and day types was first collected in 2012, and has been updated with more recent data with the latest update to the types 1-4 being completed in November of 2015. In using the data sets, two strategies to identify the patterns and train the models were considered:

- Using qualitative variables: such as the day of the week, the weather, special events, etc.
- Through similarities of the observed traffic flow: by making groups of similar days, just using real data, no matter what the contextual variables are (it only matters for the resulting flow profile)

Early tests with the two strategies showed that strategy number two required substantial computational effort and that both methods provided similar results; for this reason, strategy number one was chosen. Figure 2-2 shows the plots of the data for one detection station identified by day type. The various patterns can be observed within this plot with a significant variation between Weekdays, Weekends, and raining days, and only minor variation between the various weekdays.

[1] M. Omay (Battelle), ICM Evaluation – San Diego Site Cluster Analysis – Daily Incident Probability, March 2016.

Following the completion of each update to the system, that typically uses 3-4 months of new data to update the demand patterns within the system, each day type goes through a quality check to ensure that the data is able to provide a reasonable fit to the real data provided for the network area. The use of this typical day data and the previous quality checks means that this day can be used to analyze a non-incident condition within the system.

As part of the evaluation of the ICM system and the ongoing system maintenance a recent update to the travel demand data (cluster like analysis to update typical day types) was performed using data from over 200 arterial and freeway detection stations that were collected in February 2015 to May 2015.

The following are the steps involved with the update to the travel demands, and are similar to the steps that were done with previous updates and the initial development of the day types.

Step 1. Review and Update of Detection

A revision of the whole model was done and the detection was updated to account for the updates of the external systems. In this process a large number of Vehicle Detection Stations were added to the detection previously used, and 13 stations were added for just speed calibration as the stations do not cover all of the mainline lanes. Detection from five new Ramp Metering Information Systems stations were also included along SR-56. It should be noted that some of the new stations are replacements to older stations.

Step 2. Data Collection

Raw data was collected from PeMS, RAMS and CPS sources between the dates of January 2015 and May 2015 to update the historical patterns for the Monday, Tuesday/Thursday, Wednesday and Friday day types. The data were converted from the raw form to five-minute aggregated data. Figure 2-2 shows an example of the data collected for station 1108427.

Step 3. Creation of Patterns for the Different Day Types

After collecting the raw data and aggregating to 5-minute intervals, several filters were implemented, and detectors with non-valid data were identified. Some of the filters are implemented before any data treatment (detectors with PeMS Observed Parameter lower than 100, comparison with the inventory) and some of the filters were applied to discard detectors after treating the data. Some examples of the filters after grouping data are: filtering consecutive zeroes, calculating patterns only when four or more historical time series were available, and checking visually for anomalies. Figure 2-3 shows an example of a detector that was discarded due to irregular data where a distinct pattern cannot be found, as demonstrated by the spikes in each day plot.

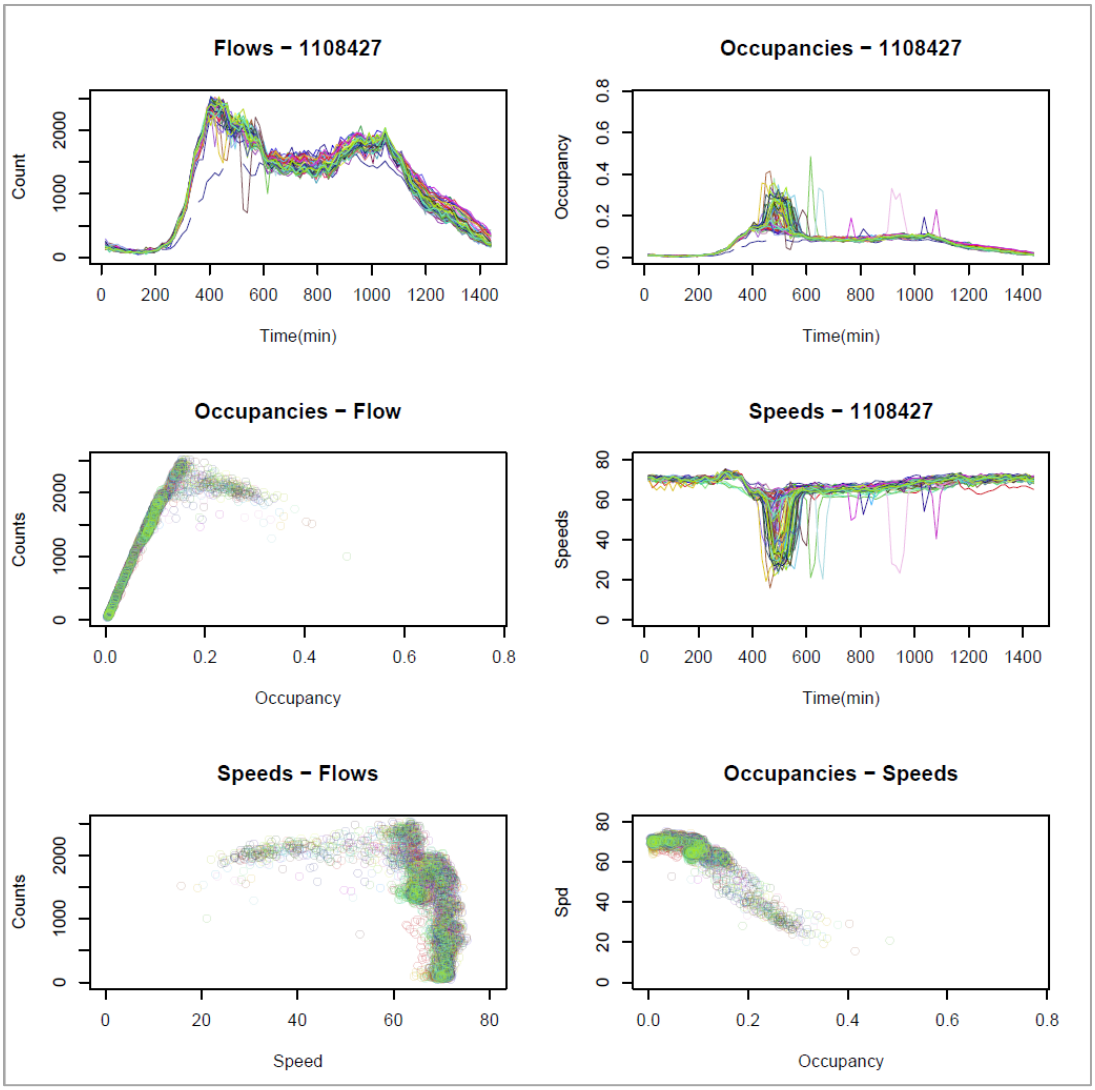

Figure 2-2: Example of Historical Data Available for Detector 1108427 (different colors represent different types of day) [Source: TSS]

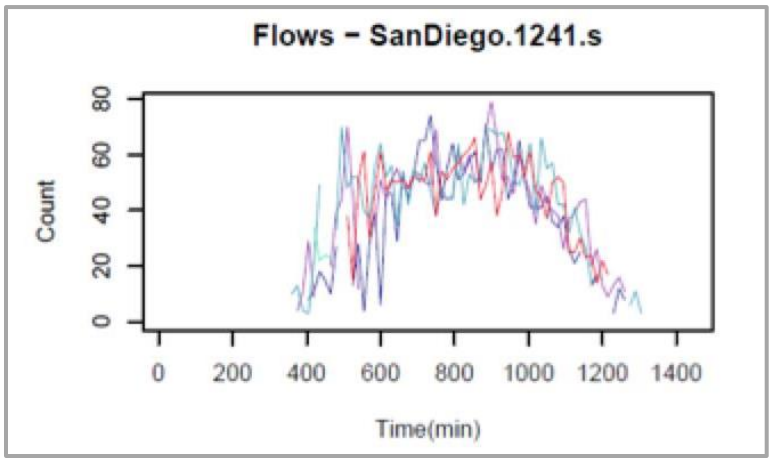

Figure 2-3: Example of Detector Discarded for Irregular Data (SanDiego.1241.s) [Source: TSS]

The historical daily time series available were grouped by type of day for weekdays, considering Monday as one pattern, Tuesday/Thursday as another, Wednesday, and finally Friday. All weekday data were classified into four different patterns. The patterns were calculated for 5, 15 and 60-minute intervals, with the 15-minute interval being the ones the study was mainly focused on. Once the historical daily time series were classified, the daily pattern was obtained by using the median values. Occasional outliers do not influence as significantly the median as they would influence the mean values. Figure 2-4 shows the example of pattern for Wednesday for detector 1100498 with 15-minute intervals (the black line is the median pattern and the orange lines are historical data).

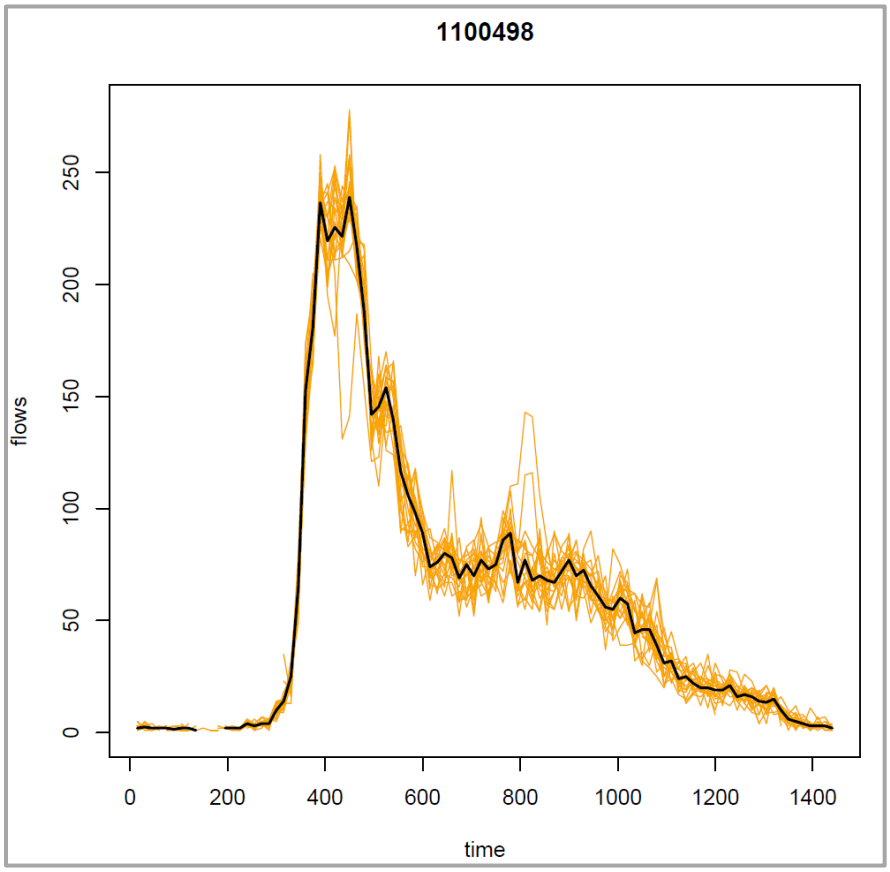

Figure 2-4: Example Wednesday Pattern Data for Detector 1100498 [Source: TSS]

Step 4. Creating and Training the Models

The same time period of data (January through May of 2015) was used to train the predictive models.

A predictive model can be described as follows: “given a time point t and a detector D, produce a prediction of the flow (or other provided measure) of that detector at time t+h, using all the information available at the moment t”.

The model can be specified as:

$$Y = f(X)$$

where:

- Y is the objective variable (flow, occupancy, or speed at time (t+h)
- X the matrix containing the necessary information to feed the model and calculate the prediction at time t
- f represents the model function which maps the input X to the desired output Y.

The dataset used to build the models comprehends the period between January and May 2015. For all the corresponding days, this set has been subset for each detector and time point of the day (with a 15 minutes offset) and within this data subset X models have been built for each forecasting horizon (15, 30, 45, 60 and 75 minutes).

The matrix X contains the explanatory variables of the model, specifically: the data of the selected detector at time t, and the data from all the neighbor detectors (upstream and downstream) within a specified travel time radius (determined by the forecasting horizon). This relation of upstream and downstream detectors in the network is calculated based on a Macro Assignment scenario that provides the paths that vehicles will follow.

The model training process has been based on the LASSO method, which adds a regularization term to LS (L1 norm). Although it may seem similar to ridge regression, it has added benefits. For instance, it performs regression and variable selection at the same time. A variant of the LASSO is the group LASSO, which penalizes groups of variables together, performing not a variable selection, but a group selection. So (regarding a group as a detector through a time window) it selects the relevant detectors, leading to a high level of interpretability in terms of traffic modeling. Elastic net is a variation of the LASSO method that deals better with multicollinearity. See [Tibshirani, 96], [Zou and Hastie, 05] and [Yuan and Lin, 06].

Finally, after the parameter calibration process, we include a validation step to measure the ability of the model to generalize when another set of new data is used (different from the data used for training). In order to select the model with higher accuracy, a 5-fold cross-validation scheme was used. This is the most standard way to ensure that the errors estimated in the training stage will be consistent with future predictions. In the 5-fold cross-validation, the set of historical days is split into 5 groups. For each group g the procedure is: Remove the group g of days (called the test sample) from the historical data. The remaining set is called the training sample. Then train the model with the training sample, evaluate predictions with the test sample, then the mean of the errors achieved by these five test samples is calculated.

<u>Step 5. Generation of Demand Matrices for each Typical Day</u>

With the patterns updated, the detector models trained, and simulation network updated the final step is to produce the typical day Origin/Destination (OD) matrices by performing OD estimation both with a static and dynamic adjustment the steps are as follows:

- Execute static adjustments, with the old matrices as the starting point, adjusting against the new pattern data. One adjustment is done for every 15 minute period for each pattern (96x4patterns static adjustments) taking into account 11 vehicle types.
- Creation of the path assignment files running a macro assignment every 15 minutes of 1-hour duration. These will be the initial paths for the dynamic adjustments.
- Execute dynamic adjustments, with the adjusted matrices from the static adjustment as the starting point, and using the path assignment files produced. The dynamic adjustment helps in redistributing the demand along the day taking into account the travel to avoid a shift in the peak hours between the demands versus the values experienced in the model/road.

Figure 2-5 and Figure 2-6 show the demand profiles for the AM and PM peak periods.

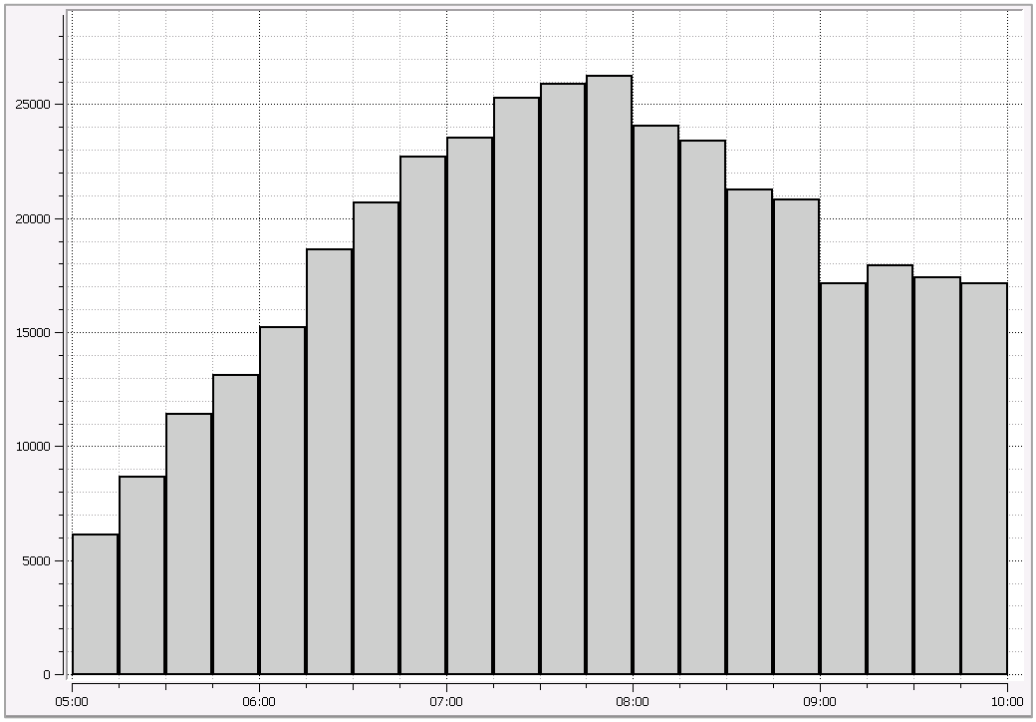

Figure 2-5: AM Travel Demand Profile (X is the 15 minute time slice between 5 and 10 AM, Y is the total number of vehicles that start a trip during the interval) [Source: TSS]

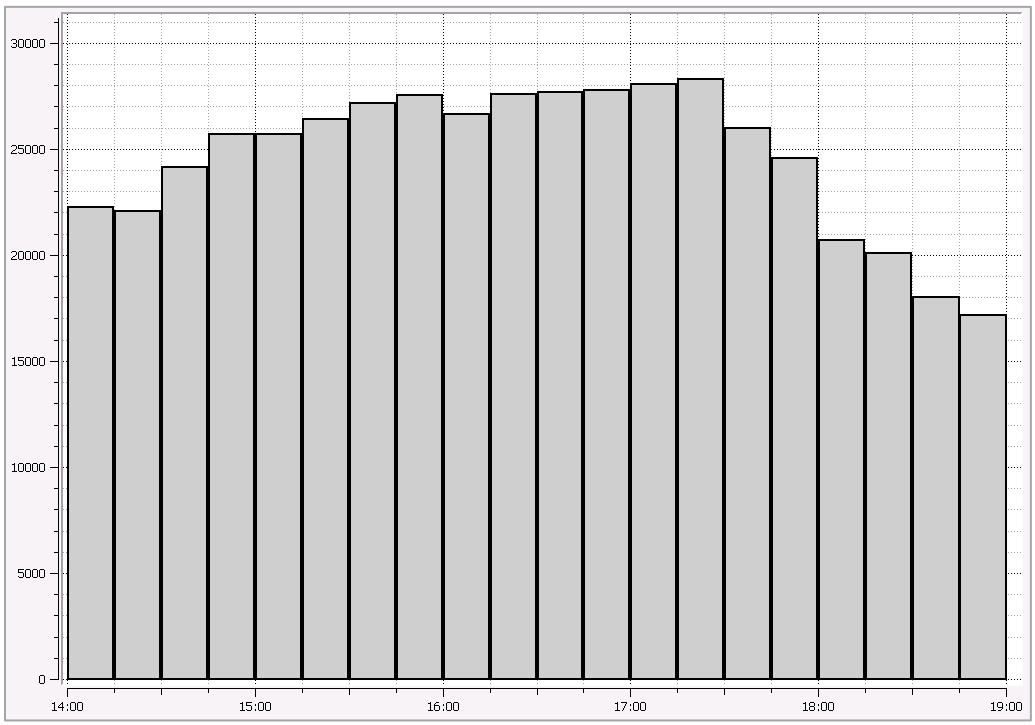

Figure 2-6: PM Travel Demand Profile (X is the 15 minute time slice between 2 and 7 PM, Y is the total number of vehicles that start a trip during the interval) [Source: TSS]

2.3 Identification of Baseline Scenarios

Based on the available data from both the AMS evaluation cluster analysis and the ICM Real Time System, four periods have been identified to be used as potential model periods for testing of the ATDM and DMA applications (Table 2-3). Of these four periods, two represent the morning peak and the other two represent the evening peak. The team has selected days for these four cases based on cluster frequencies from the completed Battelle cluster analysis report and are shown below in Table 2-3.

Table 2-3: Summary Data of Clusters and Days

	SB-MD-MI	*SB-MD-HI*	*NB-HD-HI*	*NB-HD-MI*
Representative Day	5/27/2015	2/9/2015	3/27/2015	7/7/2015
Operational Condition	Southbound (AM) + Medium Demand + Medium Incident	Southbound (AM) + Medium Demand + High Incident	Northbound (PM) + High Demand + High Incident	Northbound (PM) + High Demand + Medium Incident
VPH	6,201	6,348	9,034	8,870
Total Cluster Delay (mins)	49.88	108.03	99.72	63.25
Number of Incidents/Period	1.9	3.7	5.5	2.1

Chapter 3. Model Calibration Methodology

This chapter describes the methodology used to calibrate the underlying model against the selected baseline data for the typical days used for the ICM model.

This chapter describes the calibration methodology and illustrates how the different model parameters are adjusted such that the observed traffic pattern and associated congestion phenomena are replicated. Figure 3-1 shows evolution of the models from the San Diego ICM Online model to the individual cluster models.

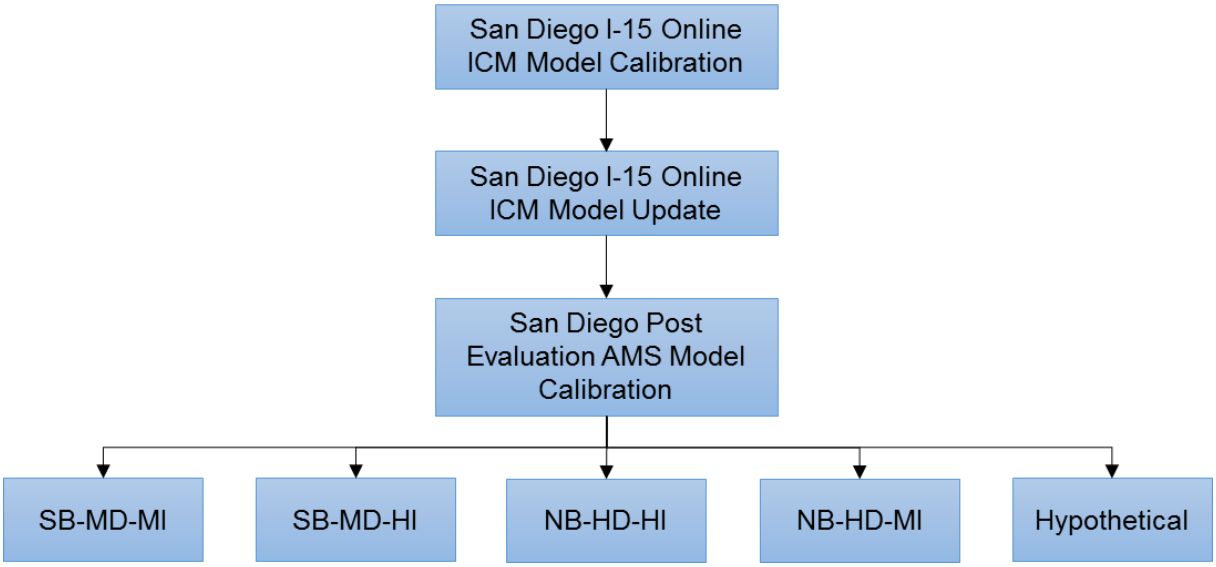

Figure 3-1: Model Calibration History [Source: TSS]

3.1 An Overview of the Calibration Methodology

The original ICM Online Aimsun model went through a full calibration and in order to prepare for the calibration steps it was important to have an understanding of the model approach that was implemented. The calibration approach applied to the San Diego I-15 ICM Aimsun Online model is based off of the approaches laid out by the FHWA within the Traffic Analysis Toolbox Volume IV[2] and Volume III[3]. Figure 3-2 (based on figure 45 from Volume IV) summarizes within a flow chart the basic iterative structure of the approach.

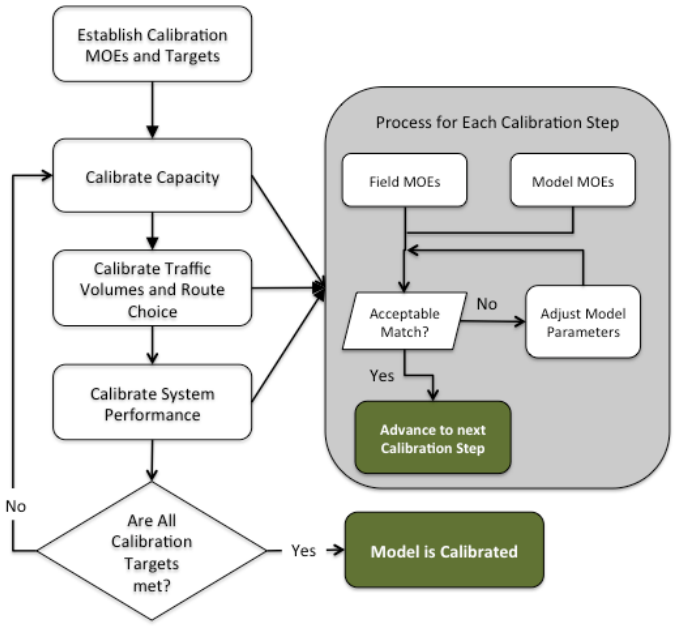

Figure 3-2: Flowchart for the Calibration Approach [Source: FHWA]

With each step of this approach the observed field observations and MOEs were compared with the model results and MOEs and the model parameters for each step are adjusted until the established targets were achieved. Once all three steps were completed and the model was deemed to be calibrated and a good representation of real world conditions it was seen as being valid. In some special cases where the model is unable to meet the targets for all occasions the model can be seen as valid as long as a justifiable reason is provided and approval given by the SANDAG review team. An example of one such situation where the targets are not met could arise when the confidence in some field results is not a 100%. In these cases, the observed data at the location in question may not line up with other observed data. For this reason, the analyst may choose to not include this location as part of the calibration data.

For the San Diego I-15 ATDM/DMA Testbed the final calibrated model from the Post ICM Evaluation was taken as the base for the cluster models; the full AMS calibration results are included in this report. For more details of the step-by-step process for the calibration of the existing ICM network the “San Diego ICMS – Simulation Calibration Performance Report” can be used. This report is available from the

[2] Peter Holm, Daniel Tomich, Jaimie Sloboden, Cheryl Lowrance, Traffic Analysis Toolbox Volume IV: Guidelines for Applying CORSIM Microsimulation Modeling Software, FHWA-HOP-07-079, Federal Highway Administration, January 2007

[3] Dowling, R., A. Skabardonis, and V. Alexiadis, Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, FHWA-HRT-04-040, Federal Highway Administration, July 2004

USDOT Research and Innovative Technology Administration. Chapters 3.2 and 3.3 outline some of the initial calibration steps and the AMS update.

3.2 I-15 Online Model Calibration

3.2.1 Capacity Calibration

The first step in the calibration process is to insure that the error-checked model correctly represents the capacity; in order to perform this task, global and local parameters are adjusted to match locally observed capacities. Below are the results of the capacity calibration for the model. This process will follow five steps as defined by the FHWA guidelines:

1. Collect/calculate field measurements of capacity.
2. Obtain model estimates of capacity.
3. Freeway capacity calibration
4. Arterial capacity calibration
5. Over all capacity check

3.2.1.1 Freeway Capacity Calibration

Using an iterative process of comparing the calculated real world capacities to the estimated model capacities the global parameters that impact the capacity of the model were adjusted. By comparing how the speeds drop with the increase in volumes and the development of congestion similar to real world conditions the Analyst was able to establish a reasonable representation of the correct capacity. Although there have been issues extracting a typical plot of capacity from the PeMS database for showing the validity of the observed capacities this section will be updated shortly to include this data.

3.2.1.2 Surface Street Capacity Calibration

Also using an iterative process similar to the freeway sections the global and local parameters associated with intersection approaches and intersection movements were adjusted. By adjusting the reaction time at stop (the time it takes for a vehicle to react from a stopped position) and the reaction time at a signal (the time it takes for a vehicle to react at a signal) the real world and modeled intersection capacities were matched. Table 3.1 below summarizes the comparison of some sample data for some congested signals and the similar data from the model. Based on the analysis the average approach capacity or saturation flow rate for a signalized location was approximately 1495 vehicles per hour per lane. The tables below show the comparison of saturation flow rates for 5 different approaches from observed data and the model intersection approaches with the revised parameters. As shown in these tables the results indicate a reasonable and acceptable match. Prior to changing the parameters, the simulated saturation flows were significantly higher than observed.

Table 3-1: Intersection Approach Capacity/Saturation Flow comparisons.

Kearny Villa/Miramar WB					
Measured			Simulated		
Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)	Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)
45	47	1253	43.8	48	1315
40	44	1320	38.9	45	1388
72	80	1333	44.7	44	1181
49	55	1347	42.5	49	1384
45	51	1360	34.4	37	1291
Average		**1323**			**1312**
Poway/Pomerado SB					
Measured			Simulated		
Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)	Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)
37	31	1508	28.8	21	1313
32	25	1406	26.3	19	1300
30	25	1500	24.2	18	1339
30	25	1500	23.2	19	1474
40	36	1620	27.6	25	1630
Average		**1507**			**1411**
Rancho Penasquitos/Carmel Mountain Road NB					
Measured			Simulated		
Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)	Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)
28	23	1479	10.9	9	1486
28	27	1736	8.9	9	1820
30	24	1440	11.4	14	2211
29	26	1614	13.7	11	1445
32	30	1688	10.9	9	1486
Average		**1619**			**1690**
Centre City Parkway/Mission EB					
Measured			Simulated		
Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)	Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)
28	24	1543	24.3	20	1481
27	20	1333	25.2	19	1357
25	21	1512	22.9	17	1336
37	24	1168	22.3	22	1776
21	21	1800	18.9	16	1524
Average		**1471**			**1495**
Bernardo Center Drive/Rancho Bernardo WB					
Measured			Simulated		
Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)	Time (sec)	Count (veh)	Saturation Flow (veh/hr/lane)
38	30	1421	14.3	13	1636
37	26	1265	9.7	8	1485
46	43	1683	35.2	29	1483
35	33	1697	32.3	19	1059
36	34	1700	22.1	26	2118
Average		**1553**			**1556**

3.2.2 ITS Applications Calibration

In order to replicate the various ITS systems that are currently part of the corridor, the modeling team created APIs to emulate their functionalities. The following list shows the ITS systems either currently operational within the system or planned:

- Ramp metering (current)
- Congestion Pricing System along I-15 (current)
- Changeable Express Lane system (planned)
- Responsive Traffic Control System (planned)

The following sections define the testing process for each of the ITS applications.

3.2.2.1 Ramp Metering

The San Diego Ramp Metering System (SDRMS) was emulated by developing an Advanced Programming Interface (API). This API was designed to recreate both the fixed time and the responsive configurations. For the locations set to fixed time the ramp rate depends on a fixed schedule. For the responsive locations the API reads the Time of Day (TOD) tables and the correct starting and end thresholds for mainline volumes. The API then activates or deactivates ramp metering depending on the threshold. When active, the API sets the flow rate based on the mainline flow or occupancy (whether the decision is based on flow or occupancy is a system setting; typically flow is used on the I-15 corridor).

Once the API was developed, it was important to check that it was operating properly, i.e. that the correct number of vehicles per green were entering, that metering was properly activated and deactivated, and that the logic was stepping through the rate table. A detailed check was performed at one location, followed by a higher level system-wide check.

The detailed check procedure was as follows:

I. Warm up the network by running a relatively low demand for several hours to ensure that the network flow is stabilized at a value other than zero.
II. Gradually increase the mainline flow to check that the ramp metering detects the change of traffic volume and reduces the input volume rate accordingly.
III. Decrease the mainline flow to check that the ramp metering increases the input volume until the shut off threshold is met and the ramp metering is turned off.
IV. Finally, increase again the mainline traffic to check that the metering is turned back on.

The detailed check was performed at Carmel Mountain Road, and it was found that throughout the process the ramp meter functioned as it was supposed to. The ramp meter turned on when the threshold value (8250 veh/hour) was reached for the associated mainline flow detector. Then as the rate increased, the rate of discharge decreased accordingly to ensure that less traffic was joining the mainline traffic. Once the rate reached its minimum release rate, the flows were decreased and it was shown that the ramp again responded accordingly by increasing the rate of discharge. Finally, when the mainline flow reached the threshold value for the shutdown (6625 veh/hour), the ramp turned off metering as expected.

Checking was then done on the entire system to ensure that it is functioning as it is supposed to. This process was a more general check and did not involve stepping through all the rates for every location:

I. It was checked that all the ramps changed entrance rates as traffic increased in the AM peak period.
II. The test was repeated for the PM peak, as different rate tables are used, in order to verify that the system was working with different sets of parameters.

In this case a visual inspection was done to determine whether the system was responding to the traffic demand that was being loaded on the system. It was shown that as the demand increased over the peak period that the rates were adjusted by the system accordingly

3.2.2.2 Congestion Pricing System (CPS)

The Congestion Pricing System (CPS) API was tested to ensure that proper prices were being calculated and that vehicles were reacting as expected to the change of cost. For this purpose, two tests were run. In the first test, the typical day model was run to determine if the system was pricing the level of traffic appropriately. In the second test, a lane closure was introduced to determine if the vehicles would re-route dynamically based on their perceived travel time cost.

In the first case, the model was run under typical day conditions with the CPS enabled. The system displays the minimum toll, which is the toll assessed for a vehicle to go from the current entry point, to the next exit point, which can either be an intermediate access point (IAP), a direct access ramp (DAR), or the end of the managed use lanes (MUL's).

This allowed for a direct comparison of the prices displayed for the minimum toll. These values are given using the TOD tables and the Entry Plaza inventory provided by the CPS system. To ensure that the system was responding to changes in demand, the section between Hale Avenue and Felicita Parkway was used. To conduct the test, values were taken on the quarter hour for the density and the toll and are displayed in Table 3-2. It can be shown that as the density changes with time that the values for the toll to the next entry/exit point at Felicita given by the CPS respond accordingly.

Table 3-2: Sample of CPS Price Calculations from the Aimsun I-15 model at Hale Avenue Entry

Time	Density [veh/mile]	Toll
7:00:00	14.49	$0.94
7:15:00	17.32	$1.13
7:30:00	15.46	$0.94
7:45:00	15.98	$0.94

These results showed that the CPS is accurately calculating the downstream density as per the methodology laid out by the Transcore documentation. This is important because the system does not use a straight average to determine the price. Instead it uses an average of only the detectors that have higher density than their immediate upstream neighbor. Which means that tolls will be charged based on the amount of congestion that is present between the user and the next free flow instance.

3.2.2.3 Changeable Express Lane System (CELS)

As part of the base model the changeable express lane system is not in operation. It is understood that the system is being tested and changed from a 2 northbound and 2 southbound lanes to 1 northbound and 3 southbound every second Wednesday; this is not seen as a typical day. The calibration of this system used the data provided by the CPS data feeds.

3.2.2.4 Responsive Traffic Control Systems (RTCS)

During the initial calibration phase the system was still being tested in the field and was not initially included as part of the calibration. Once the system was turned on in the real world the system algorithms and parameters were implemented in the models.

3.3 I-15 Post ICM Evaluation Reasonableness Assessment

The Reasonableness Assessment methodology compared the I-15 2015 model volumes, travel times, and speeds (including bottleneck locations) with field observed data in 2015. The methodology included four steps, as detailed in the following sub-chapters

3.3.1 Data Collection

The first step in the Reasonableness Assessment was to obtain the necessary data inputs. The data inputs for this assessment of the I-15 corridor included volumes observed in the field and speeds from the following sources: Freeway General Purpose (GP) Mainline Lanes; Freeway Managed Lanes (ML) – HOV & SOV (tolled); On and Off Freeway Ramps; and, Arterials.

The data used corresponded to a typical day and to a day with an incident. In calculating the typical day, data were used from a day that was clear of incidents during the peak periods. In the initial calibration of the I-15 model, as part of the implementation process, we used both static counts and live data from the external systems, as limited arterial data were available. We added further arterial data to the external data and included it as part of this analysis (please see the conclusion of the Reasonableness Assessment for a more detailed discussion). For this exercise the data sources included Caltrans Advanced Traffic Management System (ATMS), the Ramp Metering Information System (RMIS), and the Regional Arterial Management System (RAMS). Since the last update to the real-time model, a number of improvements have been made to the ATMS stations and hence this effort includes data from the stations currently in use and the stations that have been updated since the last model update using the Caltrans Performance Measures System (PeMS). Where available, we used PeMS data and whenever an issue occurred, we used external system data, filling the gaps with pattern data; this gave a higher level of fidelity to the volume and bottleneck checks than using only the current online data set.

3.3.2 Assessment Criteria

The Reasonableness Assessment methodology employed similar elements of the model calibration criteria as detailed in the FHWA Guidelines for Applying Traffic Microsimulation Modeling Software. The Reasonableness Assessment included two types of data comparison:

1. Volume Comparison – The first part determined whether the 2014 I-15 post deployment model reasonably replicates observed volume data for 2014. The criteria for comparing hourly flows between model and observed values are summarized in Table 3-3. Note that peak periods are defined as 6:00 AM to 10:00 AM for the AM peak period, 10:00 AM to 2:00 PM for Mid-Day (MD), and 3:00 PM to 7:00 PM for the PM peak period.

2. Travel Speeds and Bottlenecks – The reasonableness assessment of the model's speeds was based on a visual audit that compared speed contour diagrams from detector data from a typical weekday with modeled speed data, as shown in Table 3-3. The speed contour diagrams depict typical weekday speeds along the I-15 corridor during the AM, Mid-Day and PM peak periods as defined above.

Table 3-3: Reasonableness Assessment Criteria and Targets

Criteria and Measures	Targets
Hourly Flows, Model vs. Observed	
Traffic flows within 15% of observed volumes for links with peak-period volumes greater than 2,000 vph	For 85% of cases for links with peak-period volumes greater than 2,000 vph
Sum of all link flows	Within 5% of sum of all link counts
Visual Audits	
Individual Link Speeds: Visually acceptable Speed-Flow relationships	To analyst's satisfaction
Bottlenecks: Visually Acceptable queuing	To analyst's satisfaction - Bottleneck formation and dissipation is verified by matching the field and simulated flow breakdown rate (capacity) at bottleneck locations, verifying bottleneck queues are generally beginning at the same location and time of day in the simulation as in the field, shockwave speeds are consistent between the field and simulation, and queue dissipation and the end of queue are consistent between the field and simulation data.

3.3.3 Model vs. Observed Data Comparison

The third step of the Reasonableness Assessment involved comparing the 2014 model outputs/performance measures against field data along the I-15 Corridor. The criteria established in Step 2 were then utilized to determine whether the model results adequately replicated the field data.

3.3.4 : Travel Demand and Network Adjustments

Based on the results of the initial comparison conducted in the model vs. observed task, additional work was needed in order to adjust the overall utilization of the managed lanes in the NB direction during the peak hour. The main step in this was to adjust the travel demand distribution of vehicles that can access the managed lanes as HOV vehicles or SOV vehicles with a toll responder. After these changes were made a better fit to the real values was achieved.

3.4 I-15 San Diego ATDM/DMA Calibration

The "Post ICM Evaluation" model, which was calibrated based on the typical day dataset, was used as base to model the four cluster scenarios with incidents. For each cluster scenario, the same traffic demand (AM or PM peak for the typical day) was loaded on the network, and the time, location, scope and duration of the incident was coded on top of the base network. Each model was then fine-tuned to fit the validation criteria as outlined in Table 3-3 by comparing with the real data set for the specific day of the cluster. Furthermore, a goodness check was done for counts less than 2,000 veh/hr to provide validity to the ramps.

Finally, in order to test the MMITSS application a hypothetical incident scenario that creates a 2 hour 2 lane blockage in the NB PM typical day model around the area of Rancho Bernardo Road will be built. The red area in Figure 3-3 shows the estimated location for the hypothetical event.

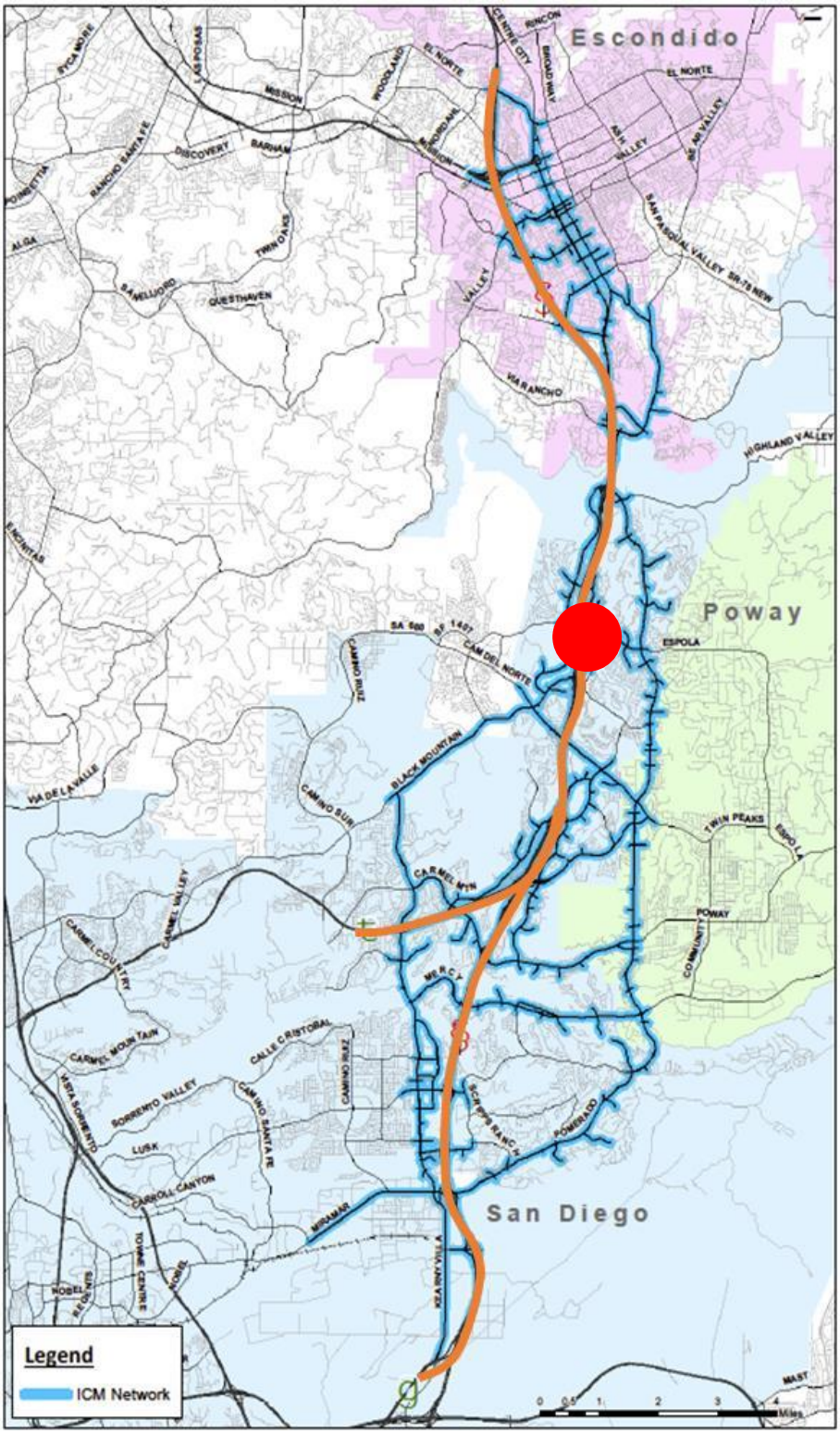

Figure 3-3: Location of the incident in the hypothetical scenario to test the MMITSS application [Source: TSS]

Chapter 4. Calibration Results

As described above, analyzing the operational conditions along the I-15 Corridor has resulted in having a typical day model and four main clusters that define the dominant operational condition for the corridor. A representative peak period is identified for each of these clusters as explained in Chapter 2. An intensive calibration effort was taken as part of the Post ICM Evaluation for the typical day model followed by 4 less extensive, due to the quality of the initial calibration, representative peak period calibrations. Thus, the model is calibrated to represent four different incident scenarios as well as both the AM Peak and the PM Peak of typical Tuesday or Thursday.

This chapter summarizes the results of the typical day calibration as well as that of each cluster. It provides a comparison between the model estimation results and the corresponding real-world observations.

4.1 Calibration Metrics

A set of comparison metrics are generated for each calibrated baseline conditions. The metrics include:

1. The percentage error between the observed and estimated hourly traffic volumes for all freeway detectors for both directions.

This error is computed as the absolute difference between the observed hourly volume and the estimated hourly volume as a percentage of the observed volume. The percentage error is calculated for each hour during the 4-hour peak periods and for each available detector. In addition, the percentage error is recorded for the entire peak period for each detector location. The count check was performed for 4 different classifications with varying targets for each. The classes are as follows:

- Flows < 750 veh/hr, target range of <15% or <150 veh/hr difference, target criteria of >75% of counts meeting target range.
- 750 veh/hr < Flows < 2000 veh/hr, target of <15%, target criteria of >75% of counts meeting target.
- Flows > 2000 veh/hr, validation target of <15%, validation criteria of >85% of counts meeting target.
- Sum of all counts validation target of <5% absolute difference.

In the calibration tables below cells are colored according to these calibration targets: green means that the target has been met, yellow that there is a negligible difference, and red when there is a significant difference.

2. Visual comparison between the observed and estimated speed profile for both freeway directions

The estimated time-varying speed profile for each detector is compared against its observed one. The detectors are ordered based on their sequence along the freeway and the speed is recorded for each observation interval (5 minutes for the typical day, 15 minute for cluster scenarios). A color code is used to indicate the level of congestion with the green representing high speed, yellow and orange representing moderate speed and red representing slow traffic. A visual inspection is used to conduct this comparison.

The objective is to ensure that the model is generally able to capture the bottleneck patterns and speed reduction associated with non-recurrent congestion, if any.

4.2 Calibration Results for Baseline – Typical Day

As described earlier, the base model on top of which the four cluster scenarios have been coded was originally built and calibrated for the USDOT ICM I-15 Post Deployment Evaluation work. The results presented in this section are for a typical weekday, using the Tuesday/Thursday averaged field data. The typical day was seen to represent a Medium Demand (MD) day type similar to the 4 clusters.

4.2.1 Link Count Comparisons

A total of 86 freeway mainline stations and 7 managed lanes stations in the AM peak period, 89 mainline stations and 7 managed lanes stations during the PM peak period and 70 mainline stations in the Inter peak period had over 8000 vehicles (equivalent of 2000 vph). None of the available arterial stations meet the 8000-vehicle threshold.

Table 4-1 shows the count comparison for all I-15 locations that meet the thresholds for the typical day. Table 4-2 and 4-3 shows the summary calibration per class for the AM and PM respectively while Table 4-4 through Table 4-7 show the AM, and PM, peak four-hour volume comparisons of the mainline and managed lanes for the observed versus modeled link detector counts. Link count differences and percent differences are also shown in these tables.

The summary of link count validations results for a typical, no incident day is as follows:

- 91 of the 93 links (97 percent) meet the 15 percent comparison criterion described in Table 8-1 for the AM peak – Criterion 1 is met for the AM Peak.
- 91 of the 96 links (94 percent) meet the 15 percent comparison criterion described in Table 8-1 for the PM peak period- Criterion 1 is met for the PM Peak.
- 69 of the 70 links (98 percent) meet the 15 percent comparison criterion described in Table 8-1 for the Inter peak period- Criterion 1 is met for the Inter Peak.
- The sum of all model link flows across all periods 6,881,464 while the sum of observed link counts is 6,879,770. These volume sums are well within 5 percent and thus Criterion 2 is met for the three combined periods.
- The sum of all model link flows in the AM peak period is 2,407,128 while the sum of observed link counts is 2,407,567. These volume sums are within 5 percent and thus Criterion 2 is met for the AM peak period.
- The sum of all model link flows in the PM peak period is 2,625,769 while the sum of observed link counts is 2,613,164. These volume sums are within 5 percent and thus Criterion 2 is for the PM peak period.
- The sum of all model link flows in the Inter peak period is 1,848,567 while the sum of observed link counts is 1,859,046. These volume sums are within 5 percent and thus Criterion 2 is for the Inter peak period.
- For all the peak periods none of the arterial counts meet the required 2000 veh/hr, thus there is no criterion to meet. Although there are differences between observed and modeled arterial volumes these counts are all included with the model sums for each period and hence the general flow of traffic along freeways and arterials meets Criterion 2.

Table 4-1: Comparison of Aggregated Traffic Volume

Modeled			Observed			Difference			Percent Error		
6-10 AM	3-7 PM	10AM-2PM	6-10 AM	3-7 PM	10AM-2PM	6-10 AM	3-7 PM	10AM-2PM	6-10 AM	3-7 PM	10AM-2PM
2,407,128	2,625,769	1,848,567	2,407,567	2,613,164	1,859,046	439	12,604	10,479	0.0%	0.5%	0.6%

Table 4-2: Summary Count Calibration AM Peak Period Results

Class	Target	Criteria	6:00	7:00	8:00	9:00	10:00
Flows <750	< 15% or < 150 veh/hr	>75%	100%	95%	89%	90%	89%
750 <Flows < 2000	< 15%	>75%	75%	91%	84%	83%	80%
Flows > 2000	< 15%	>85%	100%	98%	96%	95%	99%
Total % Matching			96%	96%	91%	91%	90%
Σ Flows	< 5%	<5%	-2%	-1%	2%	0%	-2%

Table 4-3: Summary Count Calibration PM Peak Period Results

Group	Target	Criteria	3:00	4:00	5:00	6:00	7:00
Flows <750	< 15% or < 150 veh/hr	>75%	86%	86%	85%	78%	87%
750 <Flows < 2000	< 15%	>75%	77%	88%	88%	79%	79%
Flows > 2000	< 15%	>85%	99%	93%	89%	92%	100%
Total % Matching			88%	92%	92%	88%	89%
Σ Flows	< 5%	<5%	-1%	1%	1%	1%	-2%

Table 4-4: AM Peak Period I-15 Link Count Comparison – Typical Day

Location Description	Observed Vol.	Modeled Volume	Absolute Difference	Relative Difference (%)
S/O Mercy Road	42599	43364	766	1.8%
Carroll Canyon Road	41446	43340	1894	4.6%
N/O NB I-15/163 Merge	40638	40139	499	1.2%
Miramar Road	39682	40750	1069	2.7%
Miramar Way	38096	37541	555	1.5%
Mercy Road	37622	38034	412	1.1%
North of SR-56	37611	37735	125	0.3%
Mira Mesa Boulevard	36794	39181	2387	6.5%
15 S SO Ca del Norte	36375	36920	545	1.5%
VIA PKWY	35691	34377	1314	3.7%
15 N NO Carmel Mtn	34912	36190	1279	3.7%
Green Vly Ck	34747	34436	311	0.9%
POMERADO	34567	34404	163	0.5%
Bernardo Ctr	34171	33947	224	0.7%
Pomerado Road	33550	33397	153	0.5%
Carmel Moutain Road	33392	34413	1022	3.1%
Bernardo Center Drive	33190	32159	1031	3.1%
Miramar Road	33168	32847	321	1.0%
N/O Carroll Canyon Road	32845	32644	201	0.6%
Rancho Penasquitos	31639	32079	441	1.4%
VIA PKWY	31386	30211	1175	3.7%
S/O Mercy Road	30869	30508	361	1.2%
Carrroll Canyon Road	30797	31616	820	2.7%
S/O I-15 HOV Lanes	30703	29711	992	3.2%
Via Rancho Parkway	30163	28531	1632	5.4%
Camino Del Norte	30131	30966	835	2.8%
Ted Williams Parkway	29996	30017	21	0.1%
Rancho Bernardo Road	29682	30465	784	2.6%
I-15 NB Ted Williams	28810	29100	290	1.0%
N/O 52	28513	28628	115	0.4%
Mira Mesa Boulevard	27464	26724	740	2.7%
15 NB N/O Poway Rd	27380	27670	291	1.1%
Centre City Parkway	27345	25374	1971	7.2%
15 N SO Ca del Norte	26914	26185	729	2.7%
Mercy/Scripps Poway	26638	26368	270	1.0%
Kearny Villa Road	26399	27164	765	2.9%
Poway/Rancho Penasquitos	26050	25827	223	0.9%
Valley Parkway	25889	24967	922	3.6%
15 SB N/O Felicita	25868	26843	975	3.8%
Citricado Parkway	25775	23413	2362	9.2%
Carmel Mountain Road	24727	24232	495	2.0%
15 SB Felicita/DelLago	24423	25339	917	3.8%
Ted Williams Parkway	24226	24068	158	0.7%
S/O I-15 HOV Lanes	24207	25973	1766	7.3%
South of SR-78	23368	22491	877	3.8%
VIA PKWY	22775	21925	850	3.7%

Table 4-5: AM Peak Period I-15 Link Count Comparison – Typical Day (con't)

Location Description	Observed Vol.	Modeled Volume	Absolute Difference	Relative Difference (%)
9th Avenue	22730	24199	1470	6.5%
Bernardo Ctr	22527	22173	354	1.6%
Camino Del Norte	22106	21688	418	1.9%
Woodland Parkway	21854	19026	2828	12.9%
Green Vly Ck	21363	21466	104	0.5%
POMERADO	21076	20794	282	1.3%
SR-78 WB	21065	21157	92	0.4%
Pomerado Road	20856	20292	564	2.7%
El Norte Parkway	20484	19186	1298	6.3%
Via Rancho Parkway	20365	19425	940	4.6%
SR-78 EB	20295	20303	8	0.0%
Citricado Parkway	20122	18465	1657	8.2%
Rancho Bernardo Road	20115	19553	562	2.8%
15 NB N/O Felicita	20018	20010	8	0.0%
SB 15 @ CENTRE CITY	19731	20117	387	2.0%
Auto Park Way/9th Avenue	19362	17977	1385	7.2%
WB SR-78 W/O Nordahl	19336	20362	1027	5.3%
15 SB S/O Felicita	18881	18514	367	1.9%
San Diego/Imperial	16046	14630	1416	8.8%
San Diego/Imperial	12754	13256	503	3.9%
West of I-15	11515	11513	2	0.0%
BLACK MOUNTAIN RD	10857	10806	51	0.5%
Mercy Rd SB ML	10684	10022	662	6.2%
San Diego/Imperial	10630	10156	474	4.5%
Via Rancho Pkwy SB ML	10224	11002	778	7.6%
VIA PKWY	10193	11008	816	8.0%
POMERADO	10178	11022	845	8.3%
Green Vly Ck	10153	11029	876	8.6%
SB Centre City Parkway	9800	9488	312	3.2%
Bernardo Ctr Dr SB ML	9562	10213	651	6.8%
Miramar Rd SB ML	9440	9338	102	1.1%
Carmel Mtn Rd SB ML	9424	9242	182	1.9%
Poway Rd SB ML	9361	9215	146	1.6%
HOV South of MercyRd	9266	9009	257	2.8%
HOV North of SR56	9263	9243	20	0.2%
15 S HV NO Carmel Mt	9217	9244	28	0.3%
15 SB HOV S/O Mir Rd	9128	7650	1478	16.2%
VIA PKWY	9006	10225	1220	13.5%
15 SB HOV N/O Carrol	8991	8745	246	2.7%
Bernardo Ctr	8968	9674	706	7.9%
RCH BERN	8913	9732	820	9.2%
NB 15 @ CENTRE CITY	8827	8162	665	7.5%
15 SB HOV S/O Felic	8649	10263	1615	18.7%
Felicita Rd SB ML	8423	7410	1013	12.0%
NB I-15 N/O SR-78	8416	9345	930	11.0%
15 SB HOV S/O Camino	8233	8489	256	3.1%
HOV Valley Pkwy	8057	7405	652	8.1%

Table 4-6: PM Peak Period I-15 Link Count Comparison – Typical Day

Location Description	Observed Vol.	Modeled Volume	Absolute Difference	Relative Difference (%)
N/O NB I-15/163 Merge	43873	40972	2901	6.6%
N/O Carroll Canyon Road	42964	41011	1953	4.5%
S/O Mercy Road	40737	41434	697	1.7%
Miramar Way	40621	40391	230	0.6%
Carrroll Canyon Road	39463	38775	688	1.7%
Miramar Road	39150	37447	1703	4.3%
I-15 NB Ted Williams	38453	39838	1385	3.6%
VIA PKWY	37794	37497	297	0.8%
Mercy/Scripps Poway	36709	37035	326	0.9%
Green Vly Ck	35904	36283	380	1.1%
15 N SO Ca del Norte	35851	35712	139	0.4%
S/O Mercy Road	35840	34253	1587	4.4%
Miramar Road	35757	33817	1940	5.4%
Mira Mesa Boulevard	35622	35554	68	0.2%
POMERADO	34860	35352	493	1.4%
15 NB N/O Poway Rd	34551	36116	1565	4.5%
Pomerado Road	34279	34323	45	0.1%
Carroll Canyon Road	33694	32310	1384	4.1%
Bernardo Ctr	33388	32230	1158	3.5%
Poway/Rancho Penasquitos	33035	33559	525	1.6%
Rancho Bernardo Road	32558	31584	974	3.0%
Carmel Mountain Road	32479	32295	184	0.6%
Via Rancho Parkway	31845	31333	512	1.6%
North of SR?56	31650	31573	77	0.2%
Citricado Parkway	31053	29754	1299	4.2%
15 NB N/O Felicita	31015	31310	296	1.0%
Mercy Road	30773	29286	1487	4.8%
15 S SO Ca del Norte	30640	29886	754	2.5%
Ted Williams Parkway	30594	31440	846	2.8%
Camino Del Norte	30380	30285	95	0.3%
15 N NO Carmel Mtn	29805	29434	371	1.2%
Auto Park Way/9th Avenue	29780	28461	1319	4.4%
Mira Mesa Boulevard	29749	29708	41	0.1%
Rancho Penasquitos	28111	26696	1415	5.0%
15 SB S/O Felicita	27439	28386	947	3.5%
Carmel Moutain Road	27039	26712	327	1.2%
N/O 52	26938	29273	2335	8.7%
S/O I-15 HOV Lanes	26427	26135	292	1.1%
Ted Williams Parkway	26204	24349	1855	7.1%
VIA PKWY	25961	25029	932	3.6%
Bernardo Ctr	25629	24644	985	3.8%
SR-78 EB	25605	24994	611	2.4%
VIA PKWY	25110	24935	175	0.7%
Green Vly Ck	24326	23724	602	2.5%
San Diego/Imperial	24230	23548	682	2.8%
POMERADO	24186	23717	469	1.9%
Bernardo Center Drive	24178	23399	779	3.2%

Table 4-7: PM Peak Period I-15 Link Count Comparison – Typical Day (con't)

Location Description	Observed Vol.	Modeled Volume	Absolute Difference	Relative Difference (%)
Camino Del Norte	24140	23231	909	3.8%
15 SB N/O Felicita	23834	24403	569	2.4%
Pomerado Road	23537	23072	465	2.0%
San Diego/Imperial	22977	22893	84	0.4%
NB 15 @ CENTRE CITY	22615	22578	37	0.2%
Kearny Villa Road	22313	25150	2837	12.7%
Centre City Parkway	22292	21987	305	1.4%
NB I-15 N/O SR-78	22035	24697	2662	12.1%
Via Rancho Parkway	21977	21283	694	3.2%
Citricado Parkway	21841	21366	475	2.2%
I-15 SB/S Centre City Parkway	21057	21929	873	4.1%
Rancho Bernardo Road	21052	20434	618	2.9%
Valley Parkway	20866	21239	373	1.8%
Woodland Parkway	20858	19836	1022	4.9%
El Norte Parkway	20642	20578	64	0.3%
SR-78 WB	19695	20242	547	2.8%
S/O I-15 HOV Lanes	19004	20997	1994	10.5%
9th Avenue	18628	20689	2062	11.1%
WB SR-78 W/O Nordahl	17406	20831	3426	19.7%
South of SR-78	12973	14001	1028	7.9%
Black Mt to 56E	12630	12952	323	2.6%
West of I-15	11943	12039	96	0.8%
Sabre Springs	11408	11394	14	0.1%
San Diego/Imperial	11151	10745	406	3.6%
RCH BERN	11055	12070	1015	9.2%
15 NB HOV S/O Mercy	10987	11400	414	3.8%
North of Poway Rd	10895	11404	509	4.7%
Via Rancho Pkwy NB ML	10862	10498	364	3.4%
Mira MEsa NB	10821	10779	42	0.4%
VIA PKWY	10802	10499	303	2.8%
POMERADO	10718	10487	231	2.2%
El Norte Parkway	10497	9658	839	8.0%
15N HOV CARROLL CYN	10496	10176	320	3.0%
Bernardo Ctr	10318	11345	1028	10.0%
SB 15 @ CENTRE CITY	10300	10452	153	1.5%
15 N HV NO Carmel Mt	10216	12266	2050	20.1%
Carmle Mtn Rd NB ML	10213	12262	2049	20.1%
15 NB HOV S/O Camino	10170	12272	2102	20.7%
Center City Pkwy NB ML	10133	10458	325	3.2%
VIA PKWY	10037	10083	46	0.5%
Green Vly Ck	10013	9544	469	4.7%
SB Centre City Parkway	9970	10056	86	0.9%
Miramar Way NB ML	9921	10159	238	2.4%
15 NB HOV S/O Feli	9898	10463	565	5.7%
Bernardo Ctr Dr NB ML	9897	11752	1855	18.7%
BERNARDO CTR	9861	10328	468	4.7%
E78 @ BROADWAY/LINCO	9634	10944	1311	13.6%
West of I-15	9514	9628	115	1.2%
HOV North of SR56	8776	9296	520	5.9%

4.2.2 Delay, Speed and Bottleneck Comparisons

Another component of the calibration criteria listed in Table 1 is the visual audit of model speeds and bottlenecks. Modeled versus field-observed speeds and bottlenecks can be compared using speed contour diagrams. Tables 4-8 through 4-11 compare the speed contours of southbound and northbound I-15 during a typical day, generated using detector speed data from the average of PeMS for the general-purpose lanes over the February to May 2015 period (Tuesdays and Thursdays only), and the offline simulation outputs.

Comparisons of the detector and model speed contour plots show that the model is able to represent the bottleneck temporal and spatial extents for both southbound and northbound I-15 sufficiently realistically. The comparison shows that recurring congestion exists along the freeway during the AM peak in the southbound direction and during the PM peak in the northbound direction. Modeled congestion is within acceptable thresholds for observed temporal and spatial extents of observed congestion on the I-15 freeway. It should be noted that one exception is the observed queuing in the observed speeds in table 4-10 of the SB during PM conditions – Typical day. This congestion is not represented in the model as it is caused by a re-occurring condition downstream from the study area and is the representation of spillback from that condition into the freeway sections near the southern end of the model. It was decided to not calibrate to this condition using artificial capacity constraints as this would not benefit the over analysis plan and could result in an over calibration of the model.

Table 4-8: Southbound I-15 AM Observed (top) vs. Modeled (bottom) Speed Contours – Typical Day

Time	Del Norte Parkway	West Valley Parkway	Felicita Rd	Via Rancho Parkway	Pomerado Rd	Rancho Bernardo Rd	Camino del Norte	Ted Williams Parkway	Mira Mesa Blvd	Miramar Rd	Split I-15 / SR-163
5:05 AM	71	72	72	73	71	74	73	72	70	75	71
5:10 AM	72	72	72	73	71	75	73	72	70	75	72
5:15 AM	72	72	72	73	71	75	73	72	70	75	72
5:20 AM	71	72	72	74	72	75	73	72	70	74	72
5:25 AM	71	72	72	74	72	75	73	72	70	74	72
5:30 AM	71	71	71	73	71	74	72	72	69	74	71
5:35 AM	70	70	71	73	71	74	72	71	70	74	70
5:40 AM	70	70	72	70	73	71	71	70	74	70	72
5:45 AM	70	69	69	72	70	73	70	70	72	69	72
5:50 AM	69	69	69	71	69	72	69	70	70	72	69
5:55 AM	69	69	68	71	69	72	69	69	69	72	69
6:00 AM	69	69	68	71	69	71	68	69	69	71	68
6:05 AM	67	65	64	67	64	70	64	68	66	68	65
6:10 AM	67	63	61	65	62	69	62	66	63	65	63
6:15 AM	66	62	60	63	61	68	60	65	62	63	61
6:20 AM	66	62	59	62	60	66	58	64	60	62	60
6:25 AM	66	61	58	61	58	65	56	62	57	59	58
6:30 AM	66	61	57	60	57	60	53	57	54	58	56
6:35 AM	66	61	55	59	47	50	49	54	51	53	51
6:40 AM	66	60	53	57	37	43	47	50	48	51	52
6:45 AM	66	51	53	32	37	44	49	46	48	49	57
6:50 AM	66	60	51	48	26	34	43	46	40	41	44
6:55 AM	66	61	45	47	23	32	35	43	38	40	46
7:00 AM	65	61	44	43	20	30	35	43	40	38	47
7:05 AM	65	59	39	42	19	30	38	45	39	36	45
7:10 AM	65	57	35	40	19	29	36	42	38	35	45
7:15 AM	65	46	32	43	19	30	35	41	36	33	44
7:20 AM	62	33	31	44	18	29	35	39	35	33	44
7:25 AM	62	28	31	47	18	28	33	40	36	33	43
7:30 AM	59	28	30	45	18	29	33	41	37	34	41
7:35 AM	60	25	32	47	18	28	32	41	34	33	42
7:40 AM	55	24	33	44	18	28	33	43	34	35	42
7:45 AM	51	26	33	50	19	29	33	41	35	33	41
7:50 AM	48	26	37	47	20	29	31	40	31	31	42
7:55 AM	55	25	38	50	19	30	31	41	36	33	43
8:00 AM	57	27	45	46	19	28	33	42	36	34	44
8:05 AM	61	34	49	44	19	30	33	44	41	37	47
8:10 AM	63	47	53	50	22	29	35	46	42	38	46
8:15 AM	64	54	53	54	28	30	36	47	47	43	49
8:20 AM	65	58	55	53	25	29	41	52	45	42	49
8:25 AM	66	60	56	54	26	31	36	49	45	44	49
8:30 AM	67	62	59	57	26	32	42	52	48	45	51
8:35 AM	67	62	60	59	33	33	46	54	55	49	54
8:40 AM	67	63	61	60	37	37	48	56	58	56	56
8:45 AM	68	64	61	60	45	41	51	60	59	59	57
8:50 AM	68	64	62	62	49	53	55	63	61	60	58
8:55 AM	68	65	62	63	53	61	55	64	62	62	59
9:00 AM	68	64	62	63	54	64	58	64	62	63	60
9:05 AM	68	64	63	63	58	65	60	65	63	62	60
9:10 AM	68	64	63	63	61	66	60	65	64	63	61
9:15 AM	68	64	63	64	61	67	61	66	64	63	61
9:20 AM	68	64	63	64	61	68	61	66	64	64	61
9:25 AM	68	63	63	64	62	68	61	67	65	64	62
9:30 AM	68	64	63	64	62	68	61	66	65	64	62
9:35 AM	68	63	63	64	61	68	61	67	64	63	62
9:40 AM	68	64	63	64	61	68	61	67	65	64	62
9:45 AM	68	63	62	64	61	68	61	67	65	64	62
9:50 AM	68	64	63	64	62	69	61	67	65	64	62
9:55 AM	68	64	62	64	62	69	62	67	65	64	62
10:00 AM	68	64	62	64	62	69	61	67	65	64	62

Time	Del Norte Parkway	West Valley Parkway	Felicita Rd	Via Rancho Parkway	Pomerado Rd	Rancho Bernardo Rd	Camino del Norte	Ted Williams Parkway	Mira Mesa Blvd	Miramar Rd	Split I-15 / SR-163
5:05 AM	77	76	76	75	74	74	75	77	76	75	75
5:10 AM	76	75	76	73	73	73	75	75	75	73	74
5:15 AM	76	76	74	73	73	73	74	75	75	73	74
5:20 AM	75	72	75	71	72	72	74	76	73	73	74
5:25 AM	75	72	75	68	70	68	66	70	73	71	71
5:30 AM	75	72	74	67	69	68	67	70	73	70	68
5:35 AM	74	70	73	61	66	63	65	70	73	72	69
5:40 AM	75	70	72	48	61	58	59	67	70	62	66
5:45 AM	73	70	72	54	53	51	56	63	71	70	66
5:50 AM	73	68	71	43	44	49	51	62	72	71	66
5:55 AM	73	68	71	46	39	48	51	57	71	69	65
6:00 AM	73	70	70	50	43	47	41	57	71	71	65
6:05 AM	73	64	69	49	51	50	35	52	71	69	64
6:10 AM	74	59	65	52	41	48	43	54	68	62	60
6:15 AM	73	60	63	41	33	42	39	56	66	56	60
6:20 AM	73	58	61	27	30	40	41	57	68	63	59
6:25 AM	74	61	50	22	29	36	41	55	61	48	61
6:30 AM	74	61	31	21	25	32	37	52	57	47	55
6:35 AM	74	60	22	17	25	32	37	55	63	51	53
6:40 AM	74	62	18	20	25	31	39	55	54	40	56
6:45 AM	74	61	24	34	23	30	37	52	42	36	54
6:50 AM	75	69	21	44	23	30	40	56	41	36	48
6:55 AM	73	71	22	59	22	29	47	58	41	36	45
7:00 AM	74	71	29	52	47	37	48	61	47	37	46
7:05 AM	73	68	36	54	64	57	46	60	52	39	50
7:10 AM	72	68	54	54	65	62	45	61	47	38	56
7:15 AM	73	68	64	54	57	55	49	61	50	39	55
7:20 AM	72	65	64	54	59	56	50	61	53	41	55
7:25 AM	72	66	50	56	50	51	49	62	53	39	54
7:30 AM	72	61	38	51	52	51	46	66	60	44	58
7:35 AM	72	59	34	46	39	44	47	65	66	53	64
7:40 AM	72	65	62	51	24	23	48	66	68	56	63
7:45 AM	73	62	63	48	10	14	50	67	69	55	68
7:50 AM	72	59	65	40	8	14	44	61	61	47	60
7:55 AM	55	65	21	15	22	42	58	46	38	53	57
8:00 AM	73	63	64	23	17	24	44	42	44	37	48
8:05 AM	73	65	67	34	16	22	42	58	47	38	50
8:10 AM	73	64	62	36	17	23	44	62	49	39	50
8:15 AM	73	65	58	27	16	21	44	58	48	37	53
8:20 AM	74	70	62	21	18	22	33	55	42	37	52
8:25 AM	73	73	46	18	24	29	53	38	34	34	64
8:30 AM	76	74	72	66	20	27	31	54	38	36	48
8:35 AM	76	74	71	59	44	31	37	57	46	37	45
8:40 AM	75	73	72	67	67	63	42	55	56	45	49
8:45 AM	76	74	72	63	70	66	52	61	64	53	59
8:50 AM	75	72	72	65	69	65	61	70	71	63	66
8:55 AM	74	73	74	65	66	61	58	68	72	67	70
9:00 AM	75	72	74	63	65	60	60	66	70	64	66
9:05 AM	76	73	72	59	65	61	54	67	72	68	69
9:10 AM	75	73	75	58	64	57	59	65	70	68	67
9:15 AM	75	72	72	57	65	62	63	67	66	62	68
9:20 AM	75	72	74	63	64	57	63	68	65	60	67
9:25 AM	75	74	74	66	65	62	61	65	66	62	68
9:30 AM	76	73	74	64	65	62	60	67	65	60	68
9:35 AM	75	73	72	58	60	53	60	66	65	61	67
9:40 AM	75	74	75	62	65	61	62	66	65	64	68
9:45 AM	76	73	75	63	66	61	61	67	68	66	68
9:50 AM	76	75	74	64	64	57	59	65	66	63	69
9:55 AM	76	73	75	66	69	64	68	70	73	69	70
10:00 AM	76	73	75	66	69	64	68	70	68	66	72

Time	Del Norte Parkway	West Valley Parkway	Felicita Rd	Via Rancho Parkway	Pomerado Rd	Rancho Bernardo Rd	Camino del Norte	Ted Williams Parkway	Mira Mesa Blvd	Miramar Rd	Split I-15 / SR-163
5:05 AM	76	76	75	75	75	77	76	76	76	76	75
5:10 AM	76	76	76	76	76	76	76	76	76	76	76
5:15 AM	76	76	74	73	73	73	74	76	75	74	77
5:20 AM	75	75	75	73	73	74	76	76	74	75	75
5:25 AM	75	72	75	68	70	68	70	73	71	71	72
5:30 AM	75	74	67	69	68	67	70	73	70	68	70
5:35 AM	74	70	73	61	66	63	65	70	73	72	69
5:40 AM	75	70	72	48	61	58	59	67	70	62	66
5:45 AM	73	70	72	54	53	51	56	63	71	70	66
5:50 AM	73	68	71	43	44	49	51	62	72	71	66
5:55 AM	73	68	71	46	39	48	51	57	71	69	65
6:00 AM	73	70	70	50	43	47	41	57	71	71	65
6:05 AM	73	64	69	49	51	50	35	52	71	69	64
6:10 AM	74	59	65	52	41	48	43	54	68	62	60
6:15 AM	73	60	63	41	33	42	39	56	66	56	60
6:20 AM	73	58	61	27	30	40	41	57	68	63	59
6:25 AM	74	61	50	22	29	36	41	55	61	48	61
6:30 AM	74	61	31	21	25	32	37	52	57	47	55
6:35 AM	74	60	22	17	25	32	37	55	63	51	53
6:40 AM	74	62	18	20	25	31	39	55	54	40	56
6:45 AM	74	61	24	34	23	30	37	52	42	36	54
6:50 AM	75	69	21	44	23	30	40	56	41	36	48
6:55 AM	73	71	22	59	22	29	47	58	41	36	45
7:00 AM	74	71	29	52	47	37	48	61	47	37	46
7:05 AM	73	68	36	54	64	57	46	60	52	39	50
7:10 AM	72	68	54	54	65	62	45	61	47	38	56
7:15 AM	73	68	64	54	57	55	49	61	50	39	55
7:20 AM	72	65	64	54	59	56	50	61	53	41	55
7:25 AM	72	66	50	56	50	51	49	62	53	39	54
7:30 AM	72	61	38	51	52	51	46	66	60	44	58
7:35 AM	72	59	34	46	39	44	47	65	66	53	64
7:40 AM	72	65	62	51	24	23	48	66	68	56	63
7:45 AM	73	62	63	48	10	14	50	67	69	55	68
7:50 AM	72	59	65	40	8	14	44	61	61	47	60
7:55 AM	55	65	21	15	22	42	58	46	38	53	57
8:00 AM	73	63	64	23	17	24	44	42	44	37	48
8:05 AM	73	65	67	34	16	22	42	58	47	38	50
8:10 AM	73	64	62	36	17	23	44	62	49	39	50
8:15 AM	73	65	58	27	16	21	44	58	48	37	53
8:20 AM	74	70	62	21	18	22	33	55	42	37	52
8:25 AM	73	73	46	18	24	29	53	38	34	34	64
8:30 AM	76	74	72	66	20	27	31	54	38	36	48
8:35 AM	76	74	71	59	44	31	37	57	46	37	45
8:40 AM	75	73	72	67	67	63	42	55	56	45	49
8:45 AM	76	74	72	63	70	66	52	61	64	53	59
8:50 AM	75	72	72	65	69	65	61	70	71	63	66
8:55 AM	74	73	74	65	66	61	58	68	72	67	70
9:00 AM	75	72	74	63	65	60	60	66	70	64	66
9:05 AM	76	73	72	59	65	61	54	67	72	68	69
9:10 AM	75	73	75	58	64	57	59	65	70	68	67
9:15 AM	75	72	72	57	65	62	63	67	66	62	68
9:20 AM	75	72	74	63	64	57	63	68	65	60	67
9:25 AM	75	74	74	66	65	62	61	65	66	62	68
9:30 AM	76	73	74	64	65	62	60	67	65	60	68
9:35 AM	75	73	72	58	60	53	60	66	65	61	67
9:40 AM	75	74	75	62	65	61	62	66	65	64	68
9:45 AM	76	73	75	63	66	61	61	67	68	66	68
9:50 AM	76	75	74	64	64	57	59	65	66	63	69
9:55 AM	76	73	75	66	69	64	68	70	73	69	70
10:00 AM	76	73	75	66	69	64	68	70	68	66	72

Table 4-9: Northbound I-15 AM Observed (top) vs. Modeled (bottom) Speed Contours – Typical Day

Time																																							
5:05 AM	73	70	68	70	68	70	68	68	68	68	70	70	70	71	70	67	70	68	70	68	70	68	67	69	70	68	70	70	71	66	70	71	71	71	68	66	66	68	68
5:10 AM	73	71	68	70	67	70	67	68	68	68	70	69	69	71	69	67	69	67	70	67	70	68	67	69	70	68	70	70	70	66	68	71	70	70	67	65	66	68	68
5:15 AM	73	70	68	71	68	70	67	68	68	68	70	69	68	71	68	66	69	66	69	66	69	68	67	69	70	68	71	70	70	66	69	71	69	70	67	65	66	68	68
5:20 AM	73	71	68	71	68	70	68	69	69	68	70	69	69	71	69	67	69	66	70	66	70	68	67	69	70	68	71	70	70	66	68	71	70	71	67	66	66	68	68
5:25 AM	73	71	68	71	68	70	68	69	69	69	70	70	70	71	69	67	69	66	70	66	70	69	68	70	71	69	71	71	70	67	68	71	70	70	67	65	65	68	68
5:30 AM	73	70	68	71	69	70	69	69	69	70	70	70	70	71	70	67	69	66	70	66	70	69	68	70	71	68	71	71	71	67	70	71	71	71	68	65	66	69	69
5:35 AM	72	70	68	71	69	70	69	70	70	70	70	71	71	71	70	68	71	67	71	67	71	69	68	70	71	69	71	71	71	67	70	71	71	71	69	66	65	68	68
5:40 AM	72	69	68	71	69	70	69	70	69	70	70	71	72	71	71	68	71	68	71	68	71	70	69	71	72	70	72	72	72	68	71	71	71	71	69	67	65	69	69
5:45 AM	71	69	67	72	69	69	70	71	70	71	69	71	72	71	71	68	71	68	71	68	71	70	69	71	73	70	73	72	72	69	72	71	72	71	70	68	67	68	68
5:50 AM	71	69	67	72	70	69	71	71	70	71	70	71	72	71	72	68	72	69	72	69	72	70	69	71	72	70	72	72	73	69	72	71	73	71	71	69	66	69	69
5:55 AM	71	69	67	72	69	70	71	71	70	71	70	72	72	71	72	68	72	70	72	70	72	71	69	72	73	70	72	73	72	68	72	71	73	71	71	69	66	68	68
6:00 AM	71	69	67	71	69	70	70	70	69	71	70	72	72	71	73	69	72	70	72	70	72	70	69	71	72	70	72	72	72	68	72	71	72	71	71	69	67	68	69
6:05 AM	70	67	67	72	67	70	68	68	67	69	70	69	69	71	70	67	70	67	70	67	70	68	67	68	70	67	70	70	69	66	68	71	70	71	68	67	67	69	69
6:10 AM	70	67	67	72	66	69	67	67	67	68	70	68	68	71	68	66	68	65	68	65	68	66	66	67	68	66	69	69	68	65	67	71	69	71	67	66	66	69	69
6:15 AM	69	66	66	72	66	69	67	67	66	67	70	68	67	70	67	65	68	64	68	64	68	66	66	67	68	65	68	68	67	64	66	71	69	71	66	65	66	69	68
6:20 AM	68	65	66	72	66	69	67	67	66	68	69	68	67	70	67	65	67	64	67	64	67	65	66	66	67	65	68	68	67	64	66	71	69	71	66	66	66	69	69
6:25 AM	68	64	65	72	66	69	67	67	66	68	69	68	67	70	68	66	68	64	68	64	68	65	66	66	68	65	67	68	67	64	64	71	68	71	65	65	66	69	69
6:30 AM	66	63	65	72	65	68	67	67	65	67	69	68	67	70	68	66	68	65	68	65	68	66	66	67	68	66	68	68	68	65	65	71	68	71	65	65	66	69	69
6:35 AM	66	63	65	72	65	68	66	66	65	67	69	68	67	69	67	65	68	64	68	64	68	66	67	67	69	66	69	69	68	65	66	71	69	71	66	65	67	69	69
6:40 AM	65	63	64	72	65	68	66	66	65	67	69	68	67	69	67	65	68	64	69	64	69	66	67	67	69	66	68	69	68	65	66	71	69	71	67	66	68	69	69
6:45 AM	65	63	64	72	65	68	66	67	65	67	69	68	68	69	68	65	68	65	68	65	68	66	67	68	69	66	69	69	69	66	67	71	69	71	67	65	68	69	69
6:50 AM	65	62	64	72	66	68	67	67	66	67	69	68	68	69	67	65	68	65	68	65	68	66	67	68	69	66	69	70	69	66	67	71	70	71	66	64	68	69	69
6:55 AM	62	63	64	72	65	68	67	67	66	67	69	68	68	69	68	65	68	65	68	65	68	66	67	67	69	67	69	69	69	66	68	71	70	71	66	65	68	69	69
7:00 AM	63	63	65	72	65	68	67	67	66	68	69	68	68	70	68	65	69	65	69	65	69	66	67	68	69	67	69	70	69	66	67	71	70	71	65	65	68	69	69
7:05 AM	65	64	65	72	66	68	67	67	65	68	69	68	68	69	68	65	68	65	68	65	68	66	67	68	69	67	69	70	69	66	67	71	70	71	66	65	67	70	69
7:10 AM	66	64	65	72	65	68	67	67	66	68	69	68	68	69	68	65	68	65	68	65	68	67	67	68	69	67	69	69	69	66	66	71	70	71	66	65	66	69	69
7:15 AM	66	64	65	71	65	68	67	67	66	68	68	68	68	69	68	65	68	64	68	64	68	66	67	68	69	67	69	69	69	66	66	71	69	71	66	64	66	69	69
7:20 AM	66	63	65	71	65	68	67	67	66	68	68	68	68	69	68	65	68	65	68	65	68	66	67	68	69	66	69	69	69	66	66	71	69	70	65	63	64	69	69
7:25 AM	64	63	64	71	65	68	67	67	66	68	68	68	68	69	68	65	68	65	69	65	69	67	67	68	69	67	69	70	69	66	67	71	69	69	64	59	64	69	69
7:30 AM	62	64	64	71	65	68	67	67	66	68	68	68	68	69	68	65	68	65	68	65	68	66	67	68	69	67	69	69	69	66	67	71	69	70	64	54	64	69	69
7:35 AM	63	64	64	71	65	68	67	67	65	67	68	68	68	69	68	65	68	65	68	65	68	66	66	67	69	66	69	69	69	66	66	70	69	69	63	53	64	69	69
7:40 AM	62	64	64	70	65	68	67	67	65	67	67	68	68	69	68	64	68	65	68	65	68	66	66	67	68	66	69	69	69	65	66	70	69	69	63	50	64	69	69
7:45 AM	63	64	64	70	65	67	67	67	65	67	67	67	68	68	67	64	68	65	68	65	68	66	66	67	68	66	69	69	69	66	66	70	69	69	62	48	62	69	69
7:50 AM	61	63	64	70	65	67	67	67	65	67	67	68	68	69	68	65	68	65	68	65	68	66	66	67	68	66	68	69	68	65	65	70	69	69	61	45	62	69	69
7:55 AM	58	63	64	70	65	68	67	67	65	68	67	68	68	68	68	64	68	65	68	65	68	66	66	67	68	66	68	69	68	65	65	70	69	69	61	44	62	69	69
8:00 AM	57	63	64	70	65	67	66	67	65	67	68	68	68	69	68	64	68	66	68	66	68	66	66	67	68	66	68	69	68	65	65	70	68	69	61	45	61	69	69
8:05 AM	58	64	64	69	65	67	66	66	64	67	68	68	68	68	68	64	68	65	68	65	68	66	66	67	68	66	69	69	68	65	66	70	69	68	62	45	62	69	69
8:10 AM	63	64	64	69	65	67	66	66	64	67	67	67	67	68	67	64	67	64	68	64	68	66	66	67	68	66	68	69	68	65	65	70	69	68	62	45	62	69	69
8:15 AM	64	64	65	69	65	67	66	66	64	66	67	67	67	68	67	63	67	64	67	64	67	65	65	66	67	65	68	68	68	64	65	70	68	68	62	47	62	69	69
8:20 AM	64	64	64	69	64	67	65	65	63	66	67	67	67	68	66	64	67	64	67	64	67	65	65	65	67	65	67	68	67	64	64	70	68	68	61	47	61	69	69
8:25 AM	64	63	64	68	64	67	65	65	64	66	67	66	67	68	67	63	66	64	67	64	67	65	65	65	67	65	67	67	67	63	64	70	67	68	61	44	60	69	69
8:30 AM	63	62	64	68	64	67	65	65	63	65	67	66	67	68	66	63	66	63	67	63	67	64	64	65	67	65	67	67	67	63	64	70	67	68	61	45	60	69	69
8:35 AM	62	62	64	68	64	67	65	65	63	65	67	66	66	68	66	63	66	63	67	63	67	64	64	65	66	64	66	67	66	62	62	69	66	68	61	45	60	69	69
8:40 AM	60	63	64	68	64	67	65	65	63	65	67	66	66	68	65	63	66	63	66	63	66	64	64	64	66	64	66	66	65	62	62	69	66	68	60	43	59	69	68
8:45 AM	61	62	64	68	64	67	65	65	63	65	67	66	66	67	66	63	66	63	66	63	66	64	64	64	66	64	66	66	65	62	61	69	66	68	61	43	59	69	68
8:50 AM	62	63	64	68	64	67	65	65	63	65	67	66	66	67	66	63	65	63	66	63	66	64	64	65	66	64	66	66	66	62	62	69	66	67	60	43	59	69	68
8:55 AM	62	62	64	68	63	67	65	65	63	65	67	65	66	67	65	63	65	62	66	62	66	64	64	64	66	64	66	67	66	62	61	69	66	68	60	41	59	69	68
9:00 AM	64	63	64	68	63	67	64	64	63	65	67	66	66	68	65	63	66	62	66	62	66	64	63	64	66	63	65	66	65	62	61	69	65	68	60	44	59	68	68
9:05 AM	65	63	64	68	63	67	64	63	62	64	67	65	65	68	65	63	65	63	66	63	66	63	63	63	65	63	65	66	65	61	60	69	65	68	60	48	58	68	68
9:10 AM	64	63	65	67	62	67	63	63	62	64	67	64	65	68	64	62	65	61	65	61	65	63	63	63	65	63	65	65	64	61	60	69	65	68	61	52	58	68	68
9:15 AM	65	64	65	67	62	67	63	63	61	63	67	64	64	68	64	62	64	61	64	61	64	62	62	62	64	62	64	65	64	60	59	69	65	68	60	53	58	68	68
9:20 AM	67	65	65	67	63	67	64	63	62	64	67	64	65	68	63	62	64	61	64	61	64	62	62	62	64	62	64	65	63	60	58	69	64	68	60	56	57	68	68
9:25 AM	68	66	66	68	63	67	64	63	62	64	67	64	65	68	64	62	64	61	64	61	64	62	62	62	64	63	64	65	63	60	58	69	64	68	60	57	58	68	68
9:30 AM	69	66	66	68	63	68	64	64	62	64	67	64	65	68	64	62	64	61	65	61	65	62	63	63	64	62	64	65	63	60	58	69	64	68	60	59	58	68	68
9:35 AM	69	67	66	68	63	68	64	64	62	64	68	65	65	68	64	63	64	61	64	61	64	62	63	63	64	62	65	65	63	60	58	69	65	68	60	59	59	68	68
9:40 AM	69	66	66	68	63	68	64	64	63	64	68	65	65	68	64	62	64	61	65	61	65	62	63	63	65	62	65	65	63	60	58	69	65	67	61	60	59	68	68
9:45 AM	70	67	66	68	63	68	64	64	63	64	68	65	65	69	65	62	64	62	65	62	65	62	63	63	65	63	65	65	63	61	60	69	65	67	60	60	59	68	68
9:50 AM	70	67	66	68	63	68	64	64	63	65	68	65	65	69	65	62	64	61	65	61	65	62	63	63	65	63	65	65	64	61	60	69	65	68	61	61	59	68	68
9:55 AM	70	67	66	69	63	68	64	64	63	64	68	65	65	69	64	62	64	61	65	61	65	62	63	63	65	63	65	66	63	60	60	69	65	67	61	61	60	68	68
10:00 AM	70	67	66	69	63	68	64	63	62	64	68	64	65	69	64	62	64	61	65	61	65	61	63	63	65	62	65	65	63	60	59	69	65	68	61	60	60	69	68
		Merge I-15 / SR-163					Miramar Rd			Mira Mesa Blvd					Ted Williams						Camino Del Norte				Rancho Beranrdo Rd			Pomerado Rd		Via Rancho Parkway			Felicita Rd			West Valley Parkway		Del Norte Parkway	

Time																																							
5:05 AM	76	77	75	73	73	74	76	75	74	76	76	76	77	77	76	77	77	76	75	76	75	76	78	77	76	77	76	75	75	76	75	75	75	75	76	75	75	76	76
5:10 AM	76	77	76	74	75	75	76	76	75	76	76	76	77	77	77	77	78	77	78	77	78	77	78	76	76	78	77	76	76	77	75	76	76	76	75	75	75	75	75
5:15 AM	76	76	75	73	74	74	75	74	75	76	76	76	75	76	76	77	77	76	77	76	77	76	77	76	76	78	78	77	77	78	76	77	76	77	77	76	76	76	74
5:20 AM	75	75	75	70	73	72	76	76	76	75	76	75	75	76	75	76	75	75	75	75	75	75	76	75	75	76	76	75	75	76	75	76	76	76	75	76	77	76	76
5:25 AM	75	75	74	69	73	72	75	75	75	76	77	76	76	76	76	77	77	75	76	75	76	76	77	76	75	76	76	75	75	76	74	75	75	75	75	75	77	76	75
5:30 AM	75	74	74	66	71	71	75	75	75	75	77	77	77	77	76	77	76	76	76	76	76	76	77	75	75	77	76	75	76	77	75	76	75	75	75	75	76	76	76
5:35 AM	73	72	72	67	68	70	75	74	74	75	77	76	76	77	76	77	76	76	77	76	77	77	77	74	76	78	77	76	76	77	76	76	75	76	75	73	77	77	76
5:40 AM	74	72	72	60	69	69	75	74	74	75	75	75	75	75	75	76	76	75	76	75	76	76	76	74	75	77	77	75	75	77	76	77	77	76	76	74	77	76	76
5:45 AM	73	70	72	62	69	67	74	74	74	74	75	76	76	77	76	77	76	72	76	72	76	75	76	74	75	77	76	75	75	76	75	75	75	75	75	74	77	78	77
5:50 AM	72	68	70	57	67	66	74	72	72	73	75	75	75	76	76	77	76	74	76	74	76	76	76	76	75	76	76	75	76	77	76	76	75	76	75	72	75	75	74
5:55 AM	72	69	70	55	66	65	73	74	72	74	75	74	75	75	75	77	76	74	76	74	76	75	76	71	75	77	76	75	75	76	75	76	76	76	76	74	76	76	76
6:00 AM	71	66	68	55	67	67	73	73	73	74	76	75	75	75	75	76	76	71	75	71	75	75	76	75	75	76	76	75	76	77	75	76	75	75	75	73	77	76	77
6:05 AM	72	67	68	57	68	66	73	73	71	73	74	74	75	74	75	76	76	72	75	72	75	74	75	74	75	77	76	75	75	77	75	76	75	75	75	74	76	76	76
6:10 AM	72	71	71	63	69	68	73	73	71	74	76	75	75	75	75	76	75	72	76	72	76	76	76	73	74	76	76	75	75	76	75	75	75	75	75	72	77	77	75
6:15 AM	71	66	68	61	68	68	72	73	73	74	76	74	75	76	75	76	76	73	75	73	75	74	75	73	75	76	76	75	75	77	75	75	75	75	75	73	76	76	76
6:20 AM	66	61	65	63	69	65	72	71	71	72	74	74	74	75	75	76	76	74	74	74	74	73	75	72	73	75	75	74	75	76	75	75	75	75	74	73	76	76	74
6:25 AM	60	58	60	54	66	65	71	71	69	73	74	73	73	75	74	75	75	69	74	69	74	74	75	71	74	76	76	75	74	76	74	75	74	74	73	72	76	76	76
6:30 AM	61	56	61	55	66	60	70	71	70	71	74	73	74	74	75	76	76	66	74	66	74	72	74	69	73	75	75	73	74	76	75	75	75	75	74	70	76	76	75
6:35 AM	67	56	61	57	66	57	70	69	69	72	74	74	73	74	75	76	75	66	74	66	74	69	73	64	74	75	76	75	74	75	74	75	74	74	73	66	76	76	76
6:40 AM	68	58	59	55	63	61	67	68	68	71	74	73	74	74	74	76	75	68	73	68	73	69	73	65	72	75	74	72	73	76	74	74	74	75	71	69	76	75	75
6:45 AM	67	59	59	51	64	57	68	66	65	71	72	72	73	73	74	75	75	68	75	68	75	73	73	64	73	76	75	74	73	76	73	74	74	74	71	68	77	77	77
6:50 AM	67	59	57	53	62	50	66	66	67	72	74	73	74	74	75	76	75	62	73	62	73	67	71	66	73	75	76	73	73	76	74	75	74	74	71	67	76	75	76
6:55 AM	66	59	59	53	66	41	56	67	68	72	73	74	73	72	75	76	75	68	73	68	73	67	72	61	72	74	74	74	73	75	73	74	75	74	74	71	77	77	76
7:00 AM	62	58	59	50	63	56	64	62	66	70	71	71	73	72	75	76	75	68	74	68	74	72	73	61	73	76	75	73	72	76	73	75	74	74	72	70	76	76	75
7:05 AM	68	59	60	50	62	48	61	62	66	71	73	71	73	72	74	74	75	62	73	62	73	68	71	57	72	75	75	73	73	75	74	74	74	74	71	70	76	76	75
7:10 AM	70	62	59	51	61	54	65	61	62	68	72	72	72	71	74	75	74	66	73	66	73	65	71	58	72	74	75	73	72	75	72	73	74	74	71	70	77	77	76
7:15 AM	70	66	65	49	63	59	67	62	64	72	73	73	72	73	73	75	74	62	72	62	72	64	72	61	73	75	75	73	73	74	73	74	74	73	71	69	75	76	75
7:20 AM	62	61	61	49	63	51	67	64	64	71	73	72	72	72	74	75	74	65	72	65	72	64	67	50	68	75	74	72	72	75	73	75	74	75	70	71	75	75	76
7:25 AM	65	59	57	49	59	49	62	61	64	68	71	70	71	71	74	75	74	58	72	58	72	64	69	57	70	74	74	70	70	76	72	72	73	73	67	67	76	76	75
7:30 AM	58	60	57	50	58	50	58	54	63	68	72	72	72	69	74	75	74	66	72	66	72	62	72	58	71	74	74	71	70	74	71	72	74	75	67	68	77	77	76
7:35 AM	67	59	58	47	58	58	65	57	60	68	70	69	71	70	73	74	74	64	73	64	73	66	71	56	71	74	75	74	73	75	71	73	73	74	70	68	75	75	75
7:40 AM	66	59	52	49	53	55	57	55	60	64	71	70	72	72	74	74	74	55	70	55	70	59	66	46	72	74	75	73	73	76	72	74	75	74	71	70	76	76	76
7:45 AM	66	60	53	50	50	50	57	48	58	67	68	70	72	69	74	74	75	60	73	60	73	65	68	53	70	74	73	71	72	74	68	72	74	74	71	71	76	76	76
7:50 AM	69	60	49	49	51	47	55	47	59	67	66	72	72	69	73	73	72	57	72	57	72	59	68	57	72	75	74	72	71	75	70	74	73	74	64	68	75	76	76
7:55 AM	68	59	49	50	46	46	52	48	58	65	65	68	70	69	73	72	73	56	69	56	69	51	68	49	71	74	74	72	72	75	71	74	74	74	71	72	76	76	75
8:00 AM	69	59	45	48	44	48	48	47	59	67	69	69	69	70	73	72	73	50	69	50	69	52	64	48	71	75	74	71	72	75	71	73	72	72	67	72	75	75	75
8:05 AM	70	64	45	48	44	47	47	45	59	69	66	69	70	66	74	71	72	52	68	52	68	57	70	61	71	74	74	72	71	75	68	72	73	74	66	69	75	76	76
8:10 AM	72	68	55	54	53	50	53	47	58	63	70	69	70	68	74	73	74	59	71	59	71	54	65	50	70	75	75	72	73	76	73	73	74	74	66	71	76	76	75
8:15 AM	69	69	65	53	64	53	59	54	61	67	67	70	68	67	73	72	73	55	71	55	71	56	67	58	72	75	74	70	72	74	68	72	72	73	67	69	76	77	75
8:20 AM	70	67	65	54	62	47	65	48	59	64	70	67	71	70	73	70	72	55	67	55	67	55	61	54	69	74	73	70	71	74	71	74	74	74	71	68	75	76	75
8:25 AM	69	65	62	53	60	53	65	57	61	67	71	67	70	67	73	72	73	55	68	55	68	50	68	47	70	73	73	71	70	74	70	72	73	73	65	70	75	76	76
8:30 AM	69	65	60	49	61	54	65	56	66	70	70	68	70	71	73	71	74	62	70	62	70	55	68	59	70	73	74	71	70	75	70	74	73	74	69	69	76	76	75
8:35 AM	71	66	58	52	58	51	64	51	59	68	71	66	72	66	73	73	73	52	71	52	71	59	68	52	71	75	73	72	70	73	69	72	73	72	69	70	76	76	75
8:40 AM	72	70	68	54	65	49	65	52	61	69	71	71	71	71	74	75	74	58	70	58	70	51	68	54	70	75	75	73	72	74	70	74	74	74	66	68	75	75	74
8:45 AM	72	71	70	55	65	60	68	60	62	72	73	71	72	72	74	74	73	62	72	62	72	58	66	53	70	74	74	72	71	75	71	74	73	73	69	66	74	75	75
8:50 AM	70	68	68	57	67	59	68	62	62	70	73	72	72	72	75	74	74	63	73	63	73	65	71	61	72	74	74	71	71	75	70	73	72	73	68	67	75	75	75
8:55 AM	68	67	66	50	62	61	70	67	66	69	73	69	72	71	74	76	75	64	72	64	72	63	71	59	71	75	75	74	70	76	70	74	73	73	72	70	75	75	75
9:00 AM	69	63	63	52	62	52	65	64	65	67	71	71	73	71	74	74	73	57	73	57	73	64	70	63	73	75	74	73	73	75	70	74	74	74	70	70	74	75	74
9:05 AM	72	66	65	52	61	57	64	59	63	68	71	67	71	71	73	74	74	54	72	54	72	62	73	66	72	74	74	72	73	75	72	74	75	75	71	71	76	76	75
9:10 AM	73	71	71	54	66	61	68	64	64	69	73	69	73	72	73	74	73	62	69	62	69	53	68	54	71	75	75	73	73	75	72	74	74	74	70	70	74	75	76
9:15 AM	71	68	69	54	68	60	70	69	68	71	74	72	73	74	74	75	75	65	71	65	71	58	71	58	70	73	73	71	69	74	69	73	73	73	71	71	76	75	74
9:20 AM	72	71	70	54	66	64	69	65	65	70	74	71	73	73	75	76	75	69	73	69	73	65	70	57	70	74	74	72	71	75	71	73	73	73	67	67	75	75	75
9:25 AM	74	69	70	55	65	63	70	67	68	70	74	73	72	72	75	76	74	63	72	63	72	64	71	66	72	75	74	72	70	75	71	75	74	74	70	69	75	75	75
9:30 AM	73	71	71	54	67	63	70	68	68	69	73	72	73	74	74	74	74	62	72	62	72	58	70	59	70	75	74	71	72	75	73	74	74	74	72	69	76	77	76
9:35 AM	74	72	71	54	65	64	71	71	67	72	74	70	71	73	74	74	74	62	72	62	72	65	71	61	72	75	74	72	72	75	71	74	73	73	71	68	75	76	75
9:40 AM	73	72	71	55	68	65	72	71	69	71	74	71	74	74	75	76	74	64	71	64	71	59	72	62	69	73	74	71	72	75	73	73	73	74	69	67	75	75	75
9:45 AM	73	71	72	59	66	65	73	67	68	71	73	71	72	72	75	75	75	65	73	65	73	63	70	57	70	74	72	69	71	75	71	73	73	73	71	65	74	75	74
9:50 AM	73	72	72	58	68	63	72	67	67	72	74	71	71	73	73	73	74	61	73	61	73	66	71	55	72	74	72	70	70	75	72	71	73	72	70	66	75	76	75
9:55 AM	74	72	71	60	68	64	72	71	72	71	74	73	73	72	74	75	74	64	73	64	73	60	69	56	71	74	74	70	72	75	72	74	74	73	67	65	74	75	74
10:00 AM	73	73	73	62	69	69	73	70	71	72	74	73	74	74	75	75	75	69	73	69	73	67	72	59	70	75	74	70	70	74	71	72	73	73	70	67	76	76	75

Table 4-10: Southbound I-15 PM Observed (top) vs. Modeled (bottom) Speed Contours – Typical Day

Time																																						
2:05:00 PM	68	64	63	65	62	69	63	68	65	65	63	65	67	65	65	65	66	64	60	66	62	64	65	60	65	70	63	64	67	65	63	64	65	64	67	64	67	73	68
2:10:00 PM	69	65	63	65	63	69	62	68	65	65	63	65	67	65	66	65	67	64	59	66	62	64	65	60	65	70	63	64	67	66	63	63	66	64	67	64	67	73	68
2:15:00 PM	68	65	64	65	63	69	63	68	65	66	64	65	67	65	66	65	67	64	59	67	62	65	66	60	65	70	64	64	67	66	63	63	66	65	67	65	67	73	68
2:20:00 PM	68	65	65	66	64	69	63	68	65	66	64	66	68	66	66	65	67	65	59	67	62	65	66	61	65	70	63	65	67	66	64	64	66	65	67	65	67	73	68
2:25:00 PM	68	65	64	66	64	69	63	68	65	66	64	66	68	66	67	66	68	65	60	67	63	65	66	61	65	70	63	65	67	66	64	64	66	65	67	65	67	73	68
2:30:00 PM	69	66	65	66	63	69	63	67	65	66	64	66	68	66	67	66	68	65	61	67	63	65	66	61	66	70	65	65	67	67	64	63	66	65	67	65	67	73	68
2:35:00 PM	68	65	64	66	64	69	64	68	66	67	65	67	68	66	67	66	68	65	61	67	63	65	66	61	65	70	65	65	67	67	64	64	66	65	67	65	68	73	68
2:40:00 PM	69	66	65	66	64	69	64	68	66	67	65	67	68	67	67	66	68	65	61	67	63	66	67	62	66	70	65	65	67	67	64	63	66	65	67	65	67	73	68
2:45:00 PM	69	65	64	66	64	69	64	68	65	67	65	67	69	67	67	66	68	66	61	68	63	66	67	62	66	70	65	65	66	67	64	64	66	65	67	65	67	73	68
2:50:00 PM	69	65	65	67	64	69	63	68	66	67	65	67	68	67	67	67	68	66	61	68	63	66	67	62	66	70	65	65	66	67	64	64	66	65	66	65	66	72	67
2:55:00 PM	69	66	64	67	64	69	64	68	65	67	65	67	69	67	67	66	68	66	61	68	63	66	67	62	66	70	64	65	66	67	64	63	66	65	66	65	66	71	67
3:00:00 PM	69	66	65	66	64	69	63	68	65	67	65	67	69	67	67	67	68	66	61	68	63	66	67	62	66	70	65	65	66	67	64	63	66	65	66	65	67	71	67
3:05:00 PM	69	65	65	67	64	69	64	68	66	67	65	67	69	67	67	67	68	66	61	68	63	66	67	62	66	70	64	66	66	67	64	64	66	65	66	65	67	71	67
3:10:00 PM	68	66	65	67	64	69	64	68	65	67	65	67	69	67	67	67	68	66	61	68	63	66	67	63	66	70	65	66	66	67	65	65	67	65	66	65	67	71	67
3:15:00 PM	69	66	65	67	64	69	64	68	65	67	65	67	68	67	68	66	68	66	62	68	63	66	67	63	66	70	65	65	66	67	65	65	66	65	66	65	67	72	67
3:20:00 PM	68	66	65	67	64	69	64	68	65	67	65	67	68	67	67	67	68	67	61	68	63	66	67	63	66	70	65	65	66	67	65	65	66	65	65	64	66	72	67
3:25:00 PM	68	66	64	66	64	69	64	68	65	67	65	67	69	67	68	67	68	66	61	69	64	66	67	62	66	70	65	65	66	67	65	65	66	65	65	65	66	71	66
3:30:00 PM	69	66	65	67	64	69	64	67	64	67	65	67	68	67	68	67	68	66	62	68	64	66	68	62	67	70	66	65	66	67	65	65	66	65	65	65	66	71	66
3:35:00 PM	68	66	65	66	65	69	64	67	64	67	65	67	69	67	68	67	68	66	61	68	63	66	67	62	66	70	66	66	66	67	65	65	67	65	65	65	66	71	66
3:40:00 PM	69	67	65	67	65	69	64	68	64	67	65	67	69	68	68	67	68	67	61	69	63	67	68	63	67	70	66	66	66	67	65	64	66	65	65	65	66	72	66
3:45:00 PM	69	66	65	67	65	69	64	67	64	67	65	68	69	68	68	67	69	67	62	69	64	66	68	63	67	70	67	66	66	67	65	64	67	65	65	65	66	71	65
3:50:00 PM	69	67	65	67	65	69	64	67	64	67	65	67	69	68	68	67	69	67	61	69	63	67	68	63	66	69	66	66	65	67	65	62	67	65	65	65	66	71	62
3:55:00 PM	69	67	66	67	65	69	65	67	64	67	65	68	69	68	68	67	69	67	61	69	64	67	68	63	67	69	66	65	65	67	65	64	66	65	64	65	65	71	57
4:00:00 PM	69	67	66	68	65	69	65	68	64	68	65	68	69	68	69	68	69	68	62	69	64	66	68	63	67	70	66	65	65	67	65	66	66	65	64	65	65	71	50
4:05:00 PM	69	67	66	68	65	69	65	68	64	68	66	68	69	68	68	68	70	68	62	69	64	67	68	63	67	69	67	66	66	68	65	66	66	66	65	65	65	71	42
4:10:00 PM	69	68	67	68	65	69	65	68	64	68	66	68	69	68	69	68	69	68	62	69	64	67	68	64	68	70	67	66	66	69	66	66	67	66	65	65	65	71	34
4:15:00 PM	69	67	66	68	66	69	65	68	65	68	66	68	70	68	69	68	69	68	61	69	64	67	68	65	68	70	68	66	66	69	65	67	67	66	65	65	66	71	30
4:20:00 PM	69	67	66	68	65	69	65	68	65	68	65	68	69	68	69	68	70	67	62	69	64	68	68	65	68	70	68	66	66	68	66	67	67	66	65	65	65	71	26
4:25:00 PM	69	68	67	68	65	69	65	68	64	68	66	68	70	69	68	68	69	67	60	69	64	67	69	64	68	70	67	66	66	68	66	65	67	67	65	66	65	71	23
4:30:00 PM	68	68	66	68	66	69	66	68	65	68	66	68	70	69	69	68	70	68	62	69	64	67	68	64	68	70	68	66	66	69	66	66	67	67	64	66	65	71	20
4:35:00 PM	69	68	67	68	66	69	66	68	65	68	66	69	70	69	70	69	70	68	62	70	65	68	69	64	68	70	68	67	66	69	66	67	67	67	65	66	65	71	19
4:40:00 PM	69	68	67	68	66	69	65	68	65	68	66	69	70	69	69	69	70	68	62	70	65	68	69	65	68	70	68	67	66	69	66	67	68	66	65	66	65	71	20
4:45:00 PM	69	68	67	68	66	69	66	68	65	69	66	69	70	69	70	69	70	68	62	69	65	68	69	64	68	70	68	67	66	70	67	67	68	67	65	66	65	72	21
4:50:00 PM	69	69	67	69	66	69	66	68	65	69	66	69	71	70	70	69	70	68	63	70	65	68	69	64	68	69	69	67	66	69	67	67	68	67	65	66	65	72	21
4:55:00 PM	69	69	68	69	67	69	66	68	65	69	67	69	71	70	70	69	71	68	62	70	65	68	69	64	68	69	68	67	66	69	67	68	68	67	64	66	65	71	19
5:00:00 PM	69	68	67	69	67	69	66	68	65	69	67	69	71	70	70	69	71	69	62	70	65	69	70	65	69	69	68	67	66	68	67	68	68	67	65	66	65	72	19
5:05:00 PM	69	69	68	69	67	70	67	68	65	69	67	69	71	70	70	69	71	69	62	70	65	69	70	65	69	70	69	68	66	69	67	68	68	67	65	66	65	72	18
5:10:00 PM	69	69	68	69	67	69	66	68	65	69	67	69	71	70	70	69	71	69	63	70	65	69	70	66	69	70	70	68	67	70	68	67	68	67	65	66	65	72	17
5:15:00 PM	69	69	68	70	67	69	66	68	65	69	67	70	71	70	70	70	71	69	63	70	65	69	70	65	69	70	70	68	66	70	68	65	68	68	64	66	65	72	17
5:20:00 PM	69	69	68	69	67	69	66	68	65	69	67	70	71	70	70	70	71	69	63	70	65	69	70	65	69	69	69	68	66	71	68	67	69	68	64	66	65	71	18
5:25:00 PM	69	69	68	70	67	69	66	67	65	69	67	70	71	70	70	70	71	69	63	70	65	69	70	66	69	69	70	67	66	70	68	68	68	68	64	66	65	71	17
5:30:00 PM	69	70	68	70	68	69	67	68	65	69	67	70	71	70	70	70	71	69	63	70	65	69	69	65	69	69	70	67	66	70	68	68	68	67	64	66	64	71	17
5:35:00 PM	69	70	68	70	68	69	67	68	65	70	67	70	72	71	71	70	71	69	64	70	65	69	69	65	69	69	70	67	66	70	67	67	68	67	63	66	64	71	16
5:40:00 PM	69	70	68	70	68	70	68	68	65	70	67	70	71	71	71	70	71	70	63	70	65	69	69	66	69	70	70	68	66	70	68	68	68	67	64	66	64	70	16
5:45:00 PM	69	70	68	69	67	70	68	68	66	69	67	70	71	71	71	70	71	69	62	70	65	69	69	65	69	69	70	69	66	70	68	67	69	68	65	66	64	71	15
5:50:00 PM	69	70	68	70	68	70	67	68	66	69	67	70	72	71	71	70	71	69	62	70	65	69	69	66	69	69	69	69	66	71	68	68	69	68	65	67	65	72	16
5:55:00 PM	69	69	68	70	68	70	67	68	66	69	67	70	72	71	71	71	71	70	63	71	65	70	69	65	69	69	70	69	66	71	68	69	69	69	66	67	66	72	15
6:00:00 PM	69	69	68	70	68	70	67	68	66	70	68	70	71	71	70	70	71	69	62	71	65	70	69	66	70	69	70	69	67	72	68	69	69	68	66	67	66	73	16
6:05:00 PM	69	69	68	69	67	70	68	68	66	70	67	70	71	70	71	70	71	70	63	70	65	69	70	66	70	70	70	69	66	71	69	69	69	69	67	68	66	73	17
6:10:00 PM	69	69	68	69	67	70	67	68	65	69	67	70	71	70	71	70	71	70	62	71	65	70	70	66	70	70	70	69	67	71	68	68	69	69	66	68	66	73	23
6:15:00 PM	69	69	68	69	67	70	67	68	66	69	67	69	71	70	70	70	70	69	62	70	65	70	70	65	70	70	70	69	67	72	69	69	69	69	67	68	66	72	33
6:20:00 PM	69	69	68	69	67	70	67	68	66	70	67	70	71	70	70	70	70	69	63	70	64	70	70	65	70	69	69	69	67	72	69	69	69	69	67	68	66	72	40
6:25:00 PM	69	69	68	69	67	70	67	68	66	70	67	70	71	70	70	70	71	69	63	70	64	69	70	66	69	69	70	69	66	71	68	69	69	69	67	68	66	72	45
6:30:00 PM	69	68	68	69	67	70	67	68	66	70	67	70	70	70	70	70	71	70	63	71	65	69	70	66	70	70	70	69	66	71	68	68	69	69	67	68	67	72	52
6:35:00 PM	69	69	67	68	67	70	67	68	65	69	67	70	71	70	70	69	70	69	65	70	65	70	70	67	70	70	70	69	66	70	68	69	69	69	67	68	67	73	60
6:40:00 PM	69	69	67	69	67	70	67	69	66	70	67	70	71	70	70	70	70	69	64	70	65	70	70	66	70	71	70	69	67	71	68	68	69	69	67	68	67	73	63
6:45:00 PM	69	68	67	70	67	70	68	69	66	70	67	70	71	70	70	70	71	69	64	70	65	70	70	67	70	71	70	70	67	71	69	69	69	69	68	69	67	73	65
6:50:00 PM	69	69	67	70	68	71	68	69	66	70	68	70	71	71	70	69	71	69	65	71	65	70	70	68	70	71	70	70	68	71	69	69	70	69	68	68	67	74	66
6:55:00 PM	69	69	68	70	68	71	68	69	66	71	68	70	71	70	71	70	71	69	64	71	66	70	70	68	70	72	71	70	68	71	69	69	70	69	68	69	68	74	68
7:00:00 PM	69	69	68	70	68	71	69	69	67	71	68	71	72	71	71	71	71	70	65	71	66	70	70	67	70	71	71	70	68	71	69	70	70	70	69	70	68	74	68

Time	Del Norte Parkway		West Valley Parkway			Felicita Rd				Via Rancho Parkway		Pomerado Rd				Rancho Bernardo Rd			Camino del Norte					Ted Williams Parkway					Mira Mesa Blvd			Miramar Rd					Split I-15 / SR-163		
2:05:00 PM	75	74	74	56	65	60	61	67	65	61	70	70	74	74	74	72	75	72	74	74	71	67	74	69	74	72	72	75	67	73	73	75	74	74	75	74	74	74	75
2:10:00 PM	76	75	75	51	63	57	66	67	66	61	69	67	72	73	73	71	74	73	74	74	72	71	75	70	72	67	71	75	64	69	72	75	73	74	77	74	74	74	73
2:15:00 PM	75	74	75	43	58	54	65	67	64	60	70	70	72	73	73	71	74	73	74	74	72	69	75	69	73	69	72	75	70	70	72	75	74	74	75	73	74	72	73
2:20:00 PM	75	75	75	53	60	57	60	67	60	55	68	68	74	74	74	72	74	72	74	74	66	68	75	70	73	69	72	75	70	73	74	75	72	73	76	73	74	74	74
2:25:00 PM	75	74	75	57	65	58	64	67	62	58	69	70	73	74	74	73	74	71	74	74	71	68	75	69	72	67	72	76	63	73	73	74	74	73	75	72	73	74	74
2:30:00 PM	75	74	74	50	63	60	62	66	63	58	71	71	74	74	74	73	75	72	74	74	70	70	75	69	73	69	71	75	62	72	72	74	73	73	76	72	73	73	74
2:35:00 PM	76	75	74	54	62	56	66	68	58	54	71	70	73	74	74	72	73	72	74	74	72	66	74	69	73	69	71	75	67	74	72	75	73	73	73	72	74	74	73
2:40:00 PM	74	74	75	53	60	54	64	68	61	56	71	71	71	73	73	72	74	72	74	74	69	69	74	68	71	67	72	76	60	73	72	75	73	73	73	72	72	73	74
2:45:00 PM	75	75	75	61	61	58	64	68	65	61	72	71	74	74	73	72	74	72	74	75	71	67	75	68	71	65	68	75	60	68	71	74	72	72	77	71	73	73	73
2:50:00 PM	75	74	75	60	63	58	65	66	63	58	70	70	72	74	75	72	75	73	74	73	68	70	74	68	73	66	68	75	61	69	65	74	72	72	72	67	71	73	71
2:55:00 PM	75	74	73	61	66	63	65	68	66	62	70	69	72	74	74	71	75	71	74	74	70	69	74	68	72	67	71	75	62	71	66	75	73	72	66	70	71	72	72
3:00:00 PM	75	74	75	58	62	58	64	66	66	64	70	67	71	73	74	71	74	72	73	73	70	68	74	68	70	65	70	75	61	72	71	74	72	72	65	73	73	72	72
3:05:00 PM	75	75	75	61	64	61	60	65	62	56	70	68	71	72	72	70	74	71	73	73	68	66	74	67	72	66	71	75	61	58	64	72	71	71	75	67	71	72	73
3:10:00 PM	76	75	75	64	66	61	65	68	64	59	68	66	71	74	73	72	74	71	73	73	67	65	73	66	69	64	69	74	58	71	66	73	72	72	73	70	71	71	72
3:15:00 PM	75	74	74	65	62	56	58	67	67	61	70	69	72	73	74	72	75	71	74	74	63	64	74	64	71	64	62	74	59	64	69	73	71	71	74	69	72	72	73
3:20:00 PM	77	75	74	65	64	62	63	67	65	61	69	68	71	74	74	70	74	72	74	73	63	69	75	69	73	68	65	75	56	62	73	74	71	71	66	70	72	72	72
3:25:00 PM	75	74	73	59	65	60	65	68	66	60	69	70	72	74	74	71	74	71	73	72	66	66	75	66	72	67	70	76	60	65	72	73	71	72	71	68	73	70	72
3:30:00 PM	75	75	74	60	66	61	65	68	65	63	70	70	74	74	74	71	74	72	74	74	70	68	75	66	73	64	67	75	60	67	73	74	71	71	69	69	74	72	72
3:35:00 PM	75	74	74	62	61	56	64	70	66	62	70	70	73	74	74	72	75	73	74	73	68	66	74	69	71	68	69	75	61	72	68	74	72	72	76	72	71	73	72
3:40:00 PM	75	72	72	63	60	55	56	65	66	63	70	70	74	74	73	72	74	71	74	73	65	69	74	68	72	64	68	75	62	71	71	73	72	72	58	70	74	72	72
3:45:00 PM	75	74	75	55	58	53	56	65	66	64	69	68	71	74	74	71	74	72	74	74	65	68	74	68	72	70	70	75	60	69	69	73	71	71	76	69	72	71	72
3:50:00 PM	75	74	75	57	60	54	54	66	63	61	70	70	74	74	73	71	74	71	74	73	65	64	74	65	71	67	68	75	58	69	73	75	72	72	74	71	71	72	72
3:55:00 PM	74	74	75	61	62	56	61	66	64	60	69	69	71	74	74	72	75	72	74	74	70	69	75	64	71	66	63	75	62	65	67	74	71	72	71	72	73	73	74
4:00:00 PM	75	73	73	53	62	58	62	69	69	64	70	70	74	73	73	71	74	70	74	74	68	65	74	66	72	68	67	74	53	71	70	73	72	72	71	70	71	72	72
4:05:00 PM	76	76	74	54	56	52	57	65	63	60	68	68	72	73	73	70	74	69	73	72	68	70	74	68	72	68	68	75	60	70	70	72	71	71	76	72	72	71	73
4:10:00 PM	76	75	75	64	66	60	61	65	64	60	70	69	69	73	74	73	74	70	74	72	65	68	74	68	71	67	67	75	59	69	71	74	72	71	66	72	71	72	73
4:15:00 PM	74	74	74	64	68	63	71	72	69	66	72	71	71	73	74	72	74	70	74	75	69	68	73	67	71	69	67	74	61	70	70	74	72	71	76	72	71	71	74
4:20:00 PM	75	73	73	52	63	60	64	69	69	64	71	70	72	74	74	73	75	73	75	74	70	69	74	68	72	67	69	75	61	71	71	74	72	73	76	73	71	72	74
4:25:00 PM	76	75	73	62	66	59	66	69	66	61	70	69	73	73	73	70	74	71	73	74	70	69	75	70	73	71	70	76	63	73	73	74	73	73	74	72	72	72	74
4:30:00 PM	75	74	74	67	66	63	67	70	69	65	71	71	72	74	74	73	75	72	74	73	68	67	74	67	71	65	68	75	60	69	71	75	72	73	74	74	73	70	76
4:35:00 PM	74	73	75	61	61	55	60	68	68	64	71	69	74	74	75	73	75	73	74	73	67	69	75	70	72	66	68	74	63	71	69	74	72	72	74	73	72	71	75
4:40:00 PM	75	74	74	63	63	57	60	68	64	59	69	69	74	73	73	71	75	72	74	74	68	68	74	67	71	69	67	75	63	68	67	75	74	73	73	73	73	71	75
4:45:00 PM	75	75	75	54	56	55	61	67	65	62	70	70	72	74	74	69	74	71	74	73	66	64	74	66	72	69	68	75	60	70	69	74	73	73	74	74	70	72	75
4:50:00 PM	76	74	74	52	58	52	57	65	67	63	69	69	73	74	74	71	75	73	75	73	59	70	74	66	72	69	71	75	62	72	68	74	72	72	74	73	69	70	75
4:55:00 PM	76	75	75	58	60	57	58	64	63	58	68	70	74	73	73	70	74	72	74	72	62	65	74	69	72	68	69	76	59	73	70	74	72	72	71	73	73	71	76
5:00:00 PM	75	74	74	54	63	60	61	68	65	62	69	68	73	73	73	69	74	72	74	73	67	67	74	67	71	65	70	76	59	72	73	74	73	73	75	72	64	70	76
5:05:00 PM	76	75	75	58	61	55	59	66	65	64	70	70	72	74	73	71	73	71	74	73	64	69	75	68	72	65	67	75	58	71	70	75	73	73	76	73	65	72	76
5:10:00 PM	76	74	74	62	61	53	64	69	65	62	71	71	73	73	73	71	74	69	73	74	66	67	74	66	70	64	68	75	58	71	69	74	72	72	75	74	69	71	76
5:15:00 PM	76	75	75	56	62	61	61	67	68	64	72	72	74	75	74	73	75	72	74	73	67	65	74	66	71	66	68	75	57	67	70	74	72	73	74	74	72	71	75
5:20:00 PM	75	74	74	63	58	52	61	68	69	66	70	71	74	75	75	71	75	72	73	74	70	66	75	66	71	65	68	75	61	72	71	74	72	73	71	74	69	71	76
5:25:00 PM	75	74	73	57	58	54	59	67	63	60	69	70	73	73	74	71	74	72	74	74	67	64	73	64	72	63	69	75	58	71	71	75	73	73	72	73	71	70	76
5:30:00 PM	76	74	74	56	54	54	54	62	63	58	68	70	73	73	73	70	74	69	73	71	60	67	74	69	72	67	66	75	61	71	71	73	71	72	73	74	73	71	75
5:35:00 PM	76	75	74	60	56	52	60	64	62	57	66	67	69	73	73	71	74	72	74	71	56	65	72	64	69	61	64	75	52	72	73	75	73	73	77	71	62	70	75
5:40:00 PM	76	75	75	58	65	59	60	66	65	64	70	65	69	72	72	66	74	69	72	72	62	64	74	64	71	60	59	74	54	70	67	73	72	72	74	74	70	71	76
5:45:00 PM	75	74	74	60	66	62	60	67	63	61	70	70	72	74	74	73	74	72	74	73	67	66	74	65	70	65	60	75	55	71	68	74	72	72	63	73	69	70	75
5:50:00 PM	75	74	73	60	59	53	62	67	65	63	69	68	72	73	73	72	74	73	75	73	65	66	75	70	73	68	64	74	56	68	68	74	73	73	74	73	72	71	76
5:55:00 PM	76	75	73	60	64	58	60	67	66	62	70	70	74	74	75	71	74	70	73	73	68	67	74	67	71	65	69	75	62	66	69	74	73	73	73	73	74	71	75
6:00:00 PM	76	75	75	63	64	60	64	69	66	63	70	68	71	73	73	71	74	70	73	73	69	66	75	69	73	67	71	75	60	73	72	75	73	74	76	74	73	73	75
6:05:00 PM	75	75	74	59	63	58	59	67	65	60	71	72	73	75	75	72	75	72	74	74	68	66	75	69	72	66	72	75	61	73	72	75	73	73	74	74	74	73	76
6:10:00 PM	75	75	76	53	61	59	65	68	67	65	72	71	69	73	73	70	75	72	75	74	67	68	75	69	72	68	71	75	65	70	68	74	73	73	75	74	74	74	75
6:15:00 PM	75	74	74	65	65	59	63	68	66	63	72	71	72	74	74	72	75	73	74	75	71	66	75	67	73	64	72	76	65	72	72	75	74	74	74	72	73	73	75
6:20:00 PM	76	75	75	59	64	60	62	67	65	62	71	71	72	74	73	72	74	72	74	74	69	69	75	70	73	68	70	75	65	72	72	75	73	73	77	73	74	74	75
6:25:00 PM	76	75	74	64	64	59	65	69	65	64	70	69	74	74	74	73	74	73	74	74	67	67	73	66	73	71	72	75	63	72	71	74	72	72	76	74	74	74	74
6:30:00 PM	75	75	76	60	69	63	66	68	66	62	71	71	74	74	74	72	75	73	74	75	71	67	76	70	72	65	70	75	58	73	71	75	73	72	76	72	73	73	75
6:35:00 PM	76	76	75	66	69	66	69	70	68	65	71	71	75	74	74	71	75	73	74	74	72	68	75	69	73	70	73	76	66	72	72	75	73	73	71	72	73	74	74
6:40:00 PM	76	76	77	65	71	67	72	72	71	66	72	71	74	75	75	74	75	74	75	75	73	70	75	69	73	71	72	75	66	72	73	75	74	74	76	74	74	74	75
6:45:00 PM	76	75	75	70	73	68	71	71	72	69	73	72	75	75	75	74	76	74	75	75	72	73	76	73	74	71	73	76	66	72	71	75	74	74	75	73	74	75	75
6:50:00 PM	75	75	75	64	71	67	72	72	71	67	74	73	75	75	75	73	75	73	75	75	71	70	75	72	75	71	73	76	70	73	74	76	75	75	75	73	74	74	74
6:55:00 PM	77	76	77	72	74	71	72	73	72	68	72	72	75	75	75	74	75	74	75	75	74	72	75	73	74	71	72	75	66	73	73	75	74	74	77	73	74	75	75
7:00:00 PM	76	75	76	71	73	70	73	74	73	68	75	75	76	76	76	75	76	73	74	74	71	72	76	73	75	73	74	76	70	75	73	75	75	75	77	74	75	75	75

Table 4-11: Northbound I-15 PM Observed (top) vs. Modeled (bottom) Speed Contours – Typical Day

Time		Merge I-15 / SR-163					Miramar Rd			Mira Mesa Blvd					Ted Williams				Camino Del Norte				Rancho Beranrdo Rd			Pomerado Rd		Via Rancho Parkway			Felicita Rd			West Valley Parkway		Del Norte Parkway	
2:05 PM	70	67	65	66	63	67	64	64	62	64	67	65	66	68	64	62	65	61	64	62	64	63	64	63	65	65	63	59	60	68	63	67	60	60	60	68	68
2:10 PM	69	67	65	67	63	67	64	64	63	64	67	65	66	68	65	62	65	61	65	62	63	63	64	62	64	65	63	59	60	67	63	67	60	60	60	68	68
2:15 PM	70	67	65	67	63	67	64	64	63	64	67	65	66	68	65	62	65	61	65	62	64	63	65	63	64	65	63	59	60	67	63	67	60	60	60	68	68
2:20 PM	69	67	65	67	63	67	64	65	63	64	66	65	66	68	65	62	65	62	65	62	64	64	65	63	64	65	63	59	60	67	63	66	60	59	60	68	68
2:25 PM	69	67	65	67	63	67	64	64	62	63	66	64	66	68	65	62	65	62	65	63	64	64	64	63	65	65	63	59	61	67	63	66	60	60	60	68	68
2:30 PM	69	67	65	67	63	67	64	64	62	64	66	65	66	68	64	62	65	62	65	63	64	64	65	63	65	65	63	59	61	67	63	66	60	60	61	68	68
2:35 PM	69	67	65	66	63	67	64	64	62	64	66	64	66	68	65	62	65	61	65	62	63	64	64	63	64	65	63	59	61	67	64	66	60	60	61	68	68
2:40 PM	69	67	65	66	63	67	64	64	61	63	66	64	66	67	64	62	65	62	65	62	63	63	64	62	64	65	63	59	61	67	63	66	61	60	61	68	68
2:45 PM	69	66	65	67	63	67	64	64	61	63	65	64	66	67	64	62	65	62	65	62	63	63	64	62	64	65	63	59	61	66	63	65	60	60	61	68	68
2:50 PM	68	66	64	66	63	67	64	64	61	63	65	64	66	66	64	62	65	62	65	62	62	63	63	62	64	64	63	59	62	66	63	65	60	60	61	68	68
2:55 PM	68	66	64	66	63	66	64	64	61	63	65	64	66	66	64	62	65	62	65	61	61	62	63	62	63	64	63	58	62	66	63	65	61	60	61	68	68
3:00 PM	68	66	65	66	63	67	64	64	61	63	65	64	66	66	63	62	65	62	64	61	60	61	63	62	63	64	63	58	62	65	63	65	61	60	61	68	68
3:05 PM	68	66	65	66	63	67	64	64	62	64	65	64	66	66	63	62	65	62	64	61	60	61	62	62	63	63	63	58	61	65	63	65	60	60	61	67	67
3:10 PM	68	67	65	67	64	67	64	64	62	64	65	64	66	66	63	62	64	61	64	60	60	60	60	61	63	63	62	57	61	64	63	64	60	59	60	67	67
3:15 PM	68	66	65	67	64	67	64	64	62	64	65	63	66	66	62	62	65	62	64	60	60	59	60	61	63	63	62	57	60	64	63	64	60	59	61	67	67
3:20 PM	68	66	64	67	63	67	64	64	61	63	64	62	66	65	61	62	65	62	64	60	60	59	61	62	63	63	62	58	60	64	62	64	60	59	61	67	67
3:25 PM	67	65	64	66	63	66	64	64	61	62	62	62	65	62	60	62	65	62	64	59	57	54	57	61	62	63	61	58	61	64	63	64	60	59	60	67	67
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3:35 PM	66	66	64	66	63	66	64	62	59	61	62	62	62	58	59	61	64	61	63	58	46	48	48	61	63	62	62	58	61	63	63	64	59	57	60	67	67
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3:55 PM	62	63	62	65	62	61	51	42	43	52	53	58	62	59	58	61	63	54	51	40	29	31	49	59	60	61	60	56	62	63	62	63	55	50	59	66	67
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7:00 PM	70	69	67	70	67	68	68	67	65	69	67	68	70	68	69	65	70	68	70	67	67	69	69	68	69	69	69	64	69	69	69	68	65	65	65	68	68

Time																																					
2:05 PM	73	71	71	51	65	60	67	59	63	70	71	70	72	74	73	74	74	62	71	57	66	52	67	73	72	68	70	74	69	73	73	73	70	63	75	76	74
2:10 PM	72	72	71	50	64	64	71	70	68	72	73	71	72	73	73	75	75	65	71	60	67	53	68	73	73	69	70	75	69	72	72	73	66	61	75	76	74
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2:20 PM	70	68	67	53	60	60	69	66	67	70	74	71	73	74	74	75	75	60	71	61	69	53	68	73	69	65	68	75	67	70	73	73	70	54	75	75	75
2:25 PM	69	68	63	47	59	59	66	63	64	65	70	70	73	74	74	74	74	64	72	67	72	58	69	74	68	67	67	76	71	71	73	73	65	57	75	76	74
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6:35 PM	74	74	72	51	65	65	65	52	56	62	64	60	71	72	73	73	73	58	65	47	59	50	57	72	69	61	67	74	67	70	72	72	68	60	74	75	74
6:40 PM	74	74	73	56	68	65	70	68	65	69	69	58	69	70	72	73	73	64	69	49	57	35	63	73	64	63	68	74	64	72	72	72	66	63	75	76	75
6:45 PM	73	74	72	48	69	69	71	64	66	71	72	66	73	74	74	75	73	59	68	56	66	50	60	71	70	62	67	75	68	74	73	71	65	55	75	75	75
6:50 PM	74	74	72	53	67	63	70	67	67	71	72	67	72	74	74	75	74	58	71	60	70	48	69	74	70	65	69	74	66	71	71	72	67	65	75	76	75
6:55 PM	74	75	74	64	71	68	73	70	68	73	73	69	73	74	74	74	74	61	70	58	69	58	70	74	74	67	70	75	71	73	74	74	67	62	73	74	74
7:00 PM	72	74	73	52	68	64	73	71	71	74	74	72	74	76	76	76	76	62	73	60	72	61	69	74	71	67	69	75	69	74	74	74	72	70	76	76	75

4.2.3 Typical Day Summary

Verifying that the model accurately represents the current traffic conditions in the field is an important component of any modeling project and the calibration is the way of showing that accuracy. This effort helps to ensure that the Typical Day baseline model is capable of accurately representing road geometries, demands, and post ICM deployment operational conditions in 2014 and 2015. The changes made and the lessons learned through this assessment contribute to the continuous improvement of the AMS modeling approach and the use of the model for the ATDM and DMA applications.

New and more current field data were collected and several adjustments to the model were completed in order to improve the baseline model. The presence of additional information, therefore, allowed for a more accurate observed dataset to be compared to the model outputs. Having met the calibration targets, the Typical Day model (AM and PM peak periods of a normal Tuesdays and Thursdays) was considered suitable to be used as the base for the development of the cluster models and the hypothetical model. Specifically, the four models were built from SB AM-period model for typical Tuesday/Thursday and NB PM-period model for typical Tuesday/Thursday of the day types described in Section 2.1.2.

4.3 Calibration Results for Baseline – Cluster SB-MD-MI (5/27/2015)

As explained early in the process the Cluster models were developed starting from the calibrated typical day model. The first cluster SB-MD-MI includes in addition to the typical day demand, a congestion related event and a diversion related response plan. This response plan had one diversion route that used 8 signals. The diversion route assigns people travelling on SR-78 EB who normally take I-15 SB to continue on SR-78 to Center City Parkway and to enter I-15 SB using the Valley Parkway on-ramp. Table 4-12 shows the Signals that were selected by the DSS for the response plan and the time plan that was implemented. The response plan was active from 8:44 am to 9:03 am.

Table 4-12: Signalized Intersection Response Plan Data – AM-1

Device ID	Location	Plan Implemented
Caltrans.140	I-15 SB at Valley Road	6A
Caltrans.141	I-15 NB at Valley Road	6A
Escondido.100	Center City at Valley Road	3A
Escondido.40	Center City at Mission Ave	3A
Escondido.58	Center City at Washington Ave	3A
Escondido.91	La Terraza at Valley Road	6A
Escondido.94	Tulip St at Valley Road	6A
Escondido.97	Quince at Valley Road	3A

4.3.1 Link Count Comparisons

Although the calibration target was for counts greater than 2000, in order to show a goodness of fit of the model the ramp counts were also included as part of the totally summary calibration results as well as the R^2 and slope. Table 4-13 shows the summary of the calibration targets noting that both the Flows over 2000 and the sum of all flows (the two calibration target fields) are well above the guidelines.

Table 4-13: SB-MD-MI Flow Calibration Summary

Group	Target	Criteria	6:00	7:00	8:00	9:00
Flows > 2000	< 15%	>85%	92.9%	94.3%	88.6%	84.9%
All Flows	< 15%	>85%	91.5%	86.6%	81.4%	89.2%
Σ Flows	< 5%	<5%	-0.6%	-0.3%	4.3%	4.5%
R2			0.99	0.99	0.99	0.99
Slope			1.01	1.00	1.03	1.08

Tables 4-14 through 4-16 show the hourly details for the flow calibration results. It should be noted that counts that were less than 750 veh/hr were deemed valid if either the <15% difference or absolute difference is <150 (shown with a 1* in the tables) criteria were met. This is keeping with the USDOT Traffic Simulation Handbook's guidelines.

Table 4-14: SB-MD-MI Flow Calibration Details (part 1)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
El Norte Parkway (1108554)	5952	5919	0.6	4932	5519	11.9	4969	4711	5.2	4105	3723	9.3
El Norte Parkway (1119743)	1545	1439	6.8	1726	1739	0.8	2053	1973	3.9	2148	2141	0.3
56 EB TO 15 NB (1122282)	731	725	0.8	1125	1021	9.3	1062	989	6.9	876	834	4.7
15 NB HOV N/O (1122502)	241	257	6.5	345	413	1*	369	562	52.4	307	408	1*
Miramar Way (1113862)	453	492	8.7	394	467	1*	202	313	1*	199	268	1*
Carrroll Canyon Road (1108439)	6644	6843	3.0	8770	8858	1.0	8680	8823	1.6	6760	6745	0.2
Carrroll Canyon Road (1113478)	829	914	10.2	1302	1221	6.2	1163	992	14.7	540	598	10.7
Carroll Canyon Road (1108440)	194	186	4.2	402	312	1*	315	321	2.0	255	213	1*
S/O Mercy Road (1115838)	10075	10208	1.3	11086	11196	1.0	10292	10794	4.9	9747	11199	14.9
NB I-15 N/O SR-78 (1119736)	1561	1776	13.7	2178	2365	8.6	2229	2630	18.0	2181	2596	19.0
Valley Parkway (1108773)	4523	3936	13.0	4869	4489	7.8	4795	4326	9.8	4888	4373	10.5
Valley Parkway (1108774)	374	365	2.5	415	409	1.5	437	518	1*	582	496	14.7
Valley Parkway (1108556)	7018	7310	4.2	6345	6144	3.2	6220	5950	4.3	5713	5605	1.9
Auto Park Way/9th Avenue (1100601)	157	280	1*	228	472	107.1	283	403	1*	261	419	60.5
Auto Park Way/9th Avenue (1108772)	498	468	5.9	425	495	1*	406	482	1*	352	416	1*
Auto Park Way/9th Avenue (1113647)	416	341	1*	682	621	9.0	582	692	1*	388	456	1*
Auto Park Way/9th Avenue (1108771)	4234	3843	9.2	5122	4757	7.1	4951	4707	4.9	4678	4506	3.7
9th Avenue (1108558)	5935	7250	22.1	5331	5856	9.8	5242	5995	14.4	5261	5746	9.2
9th Avenue (1108559)	545	516	1*	757	931	23.0	558	847	51.8	509	554	8.9
Citricado Parkway (1100598)	150	178	1*	451	151	66.6	411	106	74.2	389	186	52.2
Citricado Parkway (1113644)	16	58	1*	55	125	1*	52	127	1*	33	82	1*
Citricado Parkway (1108769)	4350	3890	10.6	5374	4909	8.6	5245	4927	6.1	4749	4408	7.2
Citricado Parkway (1108770)	324	341	5.1	468	504	7.6	367	551	50.2	373	434	1*
Citricado Parkway (1108516)	6696	6833	2.0	6381	5687	10.9	6146	6293	2.4	5946	6179	3.9
Citricado Parkway (1108517)	332	402	1*	463	762	64.5	280	647	131.2	152	420	176.2
Center City Parkway N/O I-15 (1119438)	260	283	8.9	562	654	16.4	635	760	1*	535	596	11.4
Centre City Parkway (1108545)	7037	7101	0.9	6815	6501	4.6	6550	6861	4.7	6206	6850	10.4
Centre City Parkway (1108546)	1286	855	33.5	1537	889	42.1	1281	1036	19.2	748	797	6.6
Via Rancho Parkway (1108768)	304	246	1*	447	370	17.1	403	389	3.4	345	350	1.4
Via Rancho Parkway (1108767)	4213	3948	6.3	5424	5248	3.2	5380	5211	3.1	4835	4630	4.2
Via Rancho Parkway (1113503)	401	359	10.5	617	579	6.2	702	681	3.0	879	775	11.8
Via Rancho Parkway (1108543)	7891	7624	3.4	7825	7099	9.3	7502	7569	0.9	6351	7159	12.7
Via Rancho Parkway (1108544)	1526	1055	30.9	1753	1206	31.2	1593	1107	30.5	1131	1158	2.4
Pomerado Road (1100578)	344	139	1*	615	141	77.1	599	263	56.1	408	431	5.6
Pomerado Road (1108563)	271	267	1.3	494	481	2.7	470	558	1*	422	532	1*
Pomerado Road (1108562)	4282	4069	5.0	5461	5363	1.8	5503	5315	3.4	5159	4875	5.5
Pomerado Road (1108541)	8879	8525	4.0	8809	8165	7.3	8380	8388	0.1	6998	7961	13.8
Pomerado Road (1100524)	58	74	1*	80	120	1*	151	140	7.4	113	124	9.6
Rancho Bernardo Road (1100575)	1090	1119	2.7	1383	1288	6.8	1473	1655	12.4	1127	1120	0.7
Rancho Bernardo Road (1108595)	4151	4036	2.8	5247	5185	1.2	5341	5189	2.8	4925	4660	5.4
Rancho Bernardo Parkway (1108596)	199	183	8.1	274	295	7.7	267	322	1*	308	297	3.4
Rancho Bernardo Road (1108538)	8079	7868	2.6	7889	7809	1.0	7202	7607	5.6	6083	7260	19.4
Rancho Bernardo Road (1108540)	435	443	1.9	674	664	1.5	613	570	7.0	490	470	4.1
Rancho Bernardo Parkway (1108594)	183	171	6.4	290	286	1.4	308	334	8.4	321	260	1*
Rancho Bernardo Road (1107611)	586	590	0.7	922	966	4.8	1015	1195	17.8	839	947	12.8
Bernardo Center Drive (1100571)	413	311	1*	613	448	26.9	617	607	1.7	448	372	1*
Bernardo Center Drive (1108598)	203	171	1*	373	354	5.0	408	372	8.9	294	306	4.1
Bernardo Center Drive (1108597)	3705	3421	7.7	4519	4382	3.0	4581	4466	2.5	4230	3985	5.8
Bernardo Center Drive (1108519)	8696	8085	7.0	8862	8478	4.3	7726	8048	4.2	7084	7591	7.2
Bernardo Center Drive (1108520)	217	304	1*	339	555	63.7	300	588	95.9	307	482	57.0
Bernardo Center Drive (1107608)	508	555	9.3	947	1018	7.5	1120	1376	22.9	857	1023	19.3
Camino Del Norte (1100568)	650	574	11.8	784	844	7.6	788	820	4.1	695	729	4.8
Camino Del Norte (1108593)	279	258	7.6	391	328	16.0	359	315	12.3	313	313	0.1
Camino Del Norte (1113936)	736	836	13.6	930	1255	34.9	921	1286	39.6	662	878	32.6
Camino Del Norte (1108592)	4424	4308	2.6	5785	5758	0.5	6190	6168	0.4	5418	5275	2.6
Camino Del Norte (1108426)	848	829	2.2	1198	1015	15.3	1227	1049	14.5	1108	868	21.6
Camino Del Norte (1108425)	8037	7769	3.3	7994	8132	1.7	6522	7892	21.0	6636	7380	11.2
Carmel Mountain Road (1108590)	4638	4895	5.5	5980	6515	8.9	6135	6807	11.0	5385	5666	5.2
Carmel Moutain Road (1108427)	8753	8571	2.1	8641	8673	0.4	7184	8727	21.5	7659	8098	5.7
Ted Williams Parkway (1108589)	91	119	1*	185	229	1*	193	272	1*	174	176	1.0

Table 4-15: SB-MD-MI Flow Calibration Details (part 2)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
EB SR-56 (1113996)	462	524	13.4	996	1136	14.0	1091	1251	14.7	920	924	0.4
Ted Williams Parkway (1113985)	5205	5061	2.8	6708	6534	2.6	6773	6716	0.8	5636	5498	2.4
Ted Williams Parkway (1108429)	7477	7537	0.8	7608	7564	0.6	6659	7445	11.8	7053	7819	10.9
Ted Williams Parkway (1108430)	669	618	7.7	785	913	16.3	786	733	6.8	762	511	33.0
Rancho Penasquitos (1100560)	167	100	1*	175	135	1*	150	158	5.3	204	88	1*
Poway/Rancho Penasquitos (1113932)	572	589	3.0	950	1003	5.6	955	1122	17.5	787	934	18.7
Rancho Penasquitos (1108489)	7739	8015	3.6	7866	8230	4.6	7106	7895	11.1	7226	8519	17.9
Rancho Penasquitos (1108490)	885	849	4.1	800	714	10.8	788	598	24.2	855	646	24.4
Rancho Penasquitos (1108488)	814	815	0.1	971	1209	24.5	940	1072	14.0	789	808	2.5
Poway/Rancho Penasquitos (1108585)	5379	5508	2.4	6850	7032	2.7	7258	7110	2.0	6004	5806	3.3
Poway/Rancho Penasquitos (1108586)	257	231	10.2	523	382	1*	391	436	11.4	319	410	1*
Mercy Road (1108718)	526	508	3.4	912	961	5.4	863	941	9.1	628	751	1*
Mercy/Scripps Poway (1108717)	5669	5622	0.8	7316	7111	2.8	7428	7274	2.1	6218	5954	4.3
Mercy Road (1108450)	8998	8966	0.4	9581	9699	1.2	8749	9122	4.3	8753	9599	9.7
Mercy Road (1108451)	1058	1063	0.5	1290	1175	8.9	1254	1188	5.3	1040	950	8.7
S/O Mercy Road (1115749)	6622	6553	1.0	8791	8449	3.9	8576	8328	2.9	6964	6663	4.3
Mira Mesa Boulevard (1100553)	694	778	12.2	837	1010	20.6	893	1051	17.7	949	1229	29.5
Mira Mesa Boulevard (1108492)	400	414	3.6	840	1019	21.3	684	835	1*	411	411	0.0
Mira Mesa Boulevard (1108491)	8880	9389	5.7	9774	10184	4.2	8762	9735	11.1	8387	9984	19.0
Mira Mesa Boulevard (1108500)	141	155	10.1	333	324	2.6	244	304	1*	254	259	1.9
Mira Mesa Boulevard (1108416)	519	638	1*	801	828	3.4	755	827	9.5	641	622	3.0
Mira Mesa Boulevard (1108415)	6025	5863	2.7	7826	7383	5.7	7681	7265	5.4	6116	5865	4.1
Mira Mesa Boulevard (1108493)	878	820	6.6	1523	1399	8.2	1218	1269	4.2	928	891	4.0
Mira Mesa Boulevard (1100504)	728	1120	53.8	1174	1758	49.7	1224	1895	54.8	908	1138	25.3
N/O Carroll Canyon Road (1115739)	7009	7012	0.0	9394	9149	2.6	9225	9155	0.8	7264	6979	3.9
Carroll Canyon Road (1100542)	494	429	13.2	708	608	14.1	655	897	36.9	506	919	81.7
Carroll Canyon Road (1108148)	9086	9989	9.9	11346	11891	4.8	9981	10858	8.8	9171	10308	12.4
Carroll Canyon Road (1108518)	474	413	12.9	861	887	3.1	533	532	0.2	397	390	1.7
Miramar Road (1108495)	9181	9390	2.3	11109	11411	2.7	9613	10207	6.2	8568	9590	11.9
Miramar Road (1108496)	626	574	8.3	921	881	4.4	876	823	6.0	573	586	2.3
Miramar Road (1100549)	1084	930	14.2	1326	1336	0.7	1203	1217	1.2	1169	1117	4.4
Miramar Road (1108494)	336	309	8.0	539	473	12.3	562	477	15.2	537	596	10.9
Miramar Road (1120168)	274	267	2.5	376	403	7.1	389	463	1*	508	518	1.9
Miramar Road (1120614)	1380	1249	9.5	1264	1264	0.0	1192	1121	6.0	1108	1178	6.3
Miramar Road (1120167)	7220	7395	2.4	9608	9480	1.3	9354	9058	3.2	6759	6709	0.7
S/O Miramar Road (1115820)	8473	9126	7.7	10540	11163	5.9	9411	10305	9.5	8244	9699	17.6
Miramar Way (1108537)	40	18	1*	65	28	1*	50	42	15.2	45	21	1*
Miramar Way (1108536)	8728	8671	0.6	10932	10748	1.7	10565	10084	4.6	7858	7811	0.6
Miramar Way (1108607)	8639	9247	7.0	10978	11550	5.2	9864	10734	8.8	8695	10151	16.7
Miramar Way (1108608)	80	62	1*	92	85	7.2	80	97	1*	114	132	1*
Miramar Way (1100498)	881	890	1.0	805	845	5.0	523	502	4.0	357	252	1*
N/O NB I-15/163 Merge (1115721)	9577	9626	0.5	11736	11692	0.4	10976	10509	4.3	8182	8027	1.9
SB 15 @ CENTRE CITY (1119756)	5831	6186	6.1	5164	5957	15.4	4800	4752	1.0	4077	3906	4.2
NB 15 @ CENTRE CITY (1119749)	1877	1645	12.3	2134	1950	8.6	2387	2184	8.5	2548	2331	8.5
15 NB N/O Poway Rd (1122487)	5835	5817	0.3	7683	7564	1.5	7639	7699	0.8	6289	6312	0.4
15 SB N/O Carrol Cyn (1122479)	9955	10141	1.9	11773	12093	2.7	10384	11154	7.4	9486	10697	12.8
MIRAMAR RD (1122272)	8821	9294	5.4	10899	11356	4.2	9577	10189	6.4	8478	9557	12.7
15 NB S/O Miramar Rd (1122469)	7456	7913	6.1	9024	9935	10.1	8739	9422	7.8	6851	7148	4.3
SB 15 @AMMO RD (1117899)	8493	9255	9.0	10796	11559	7.1	9727	10773	10.7	8543	10186	19.2
Valley Parkway (1108557)	250	207	1*	315	381	1*	282	496	76.0	288	321	11.5
Pomerado Road (1108542)	197	180	8.4	274	339	1*	249	302	1*	204	153	1*
Poway/Rancho Penasquitos (1108587)	67	97	1*	104	148	1*	107	160	1*	106	79	1*
Miramar Road (1108455)	42	8	1*	153	27	1*	84	28	1*	88	12	86.1
Valley Parkway (1100604)	767	799	4.2	755	923	22.3	974	1024	5.1	843	698	1*
BERNARDO CTR (1121044)	454	267	41.1	528	399	1*	524	580	10.7	445	414	6.9
Bernardo Ctr (1121037)	4573	4464	2.4	5917	5890	0.5	6110	6030	1.3	5465	5344	2.2

Table 4-16: SB-MD-MI Flow Calibration Details (part 3)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
Bernardo Ctr (1121052)	400	343	14.2	438	510	1*	448	710	58.6	421	490	1*
Bernardo Ctr (1121051)	2621	2583	1.5	3120	3149	0.9	2429	2546	4.8	1419	1391	2.0
Bernardo Ctr (1121038)	8914	8420	5.5	9158	8904	2.8	8211	8661	5.5	7236	7936	9.7
RCH BERN (1121168)	402	346	13.9	453	523	15.5	486	734	50.9	443	517	1*
RCH BERN (1121165)	2597	2620	0.9	3126	3166	1.3	2412	2570	6.5	1312	1404	7.0
RCH BERN (1121034)	9170	9078	1.0	9338	9101	2.5	8779	9342	6.4	7228	8496	17.5
Green Vly Ck (1121099)	4367	4306	1.4	5581	5696	2.1	5698	5728	0.5	5238	5127	2.1
Green Vly Ck (1121135)	373	216	42.0	396	304	1*	429	521	1*	392	343	12.6
Green Vly Ck (1121138)	2985	2980	0.2	3607	3743	3.8	2837	3124	10.1	1458	1547	6.1
Green Vly Ck (1121105)	9122	8690	4.7	9149	8503	7.1	8661	8699	0.4	7315	8145	11.3
POMERADO (1121131)	4310	4153	3.6	5470	5491	0.4	5587	5440	2.6	5192	5006	3.6
POMERADO (1121161)	391	349	10.8	444	494	11.3	500	820	63.9	431	467	8.4
POMERADO (1121158)	2998	3003	0.2	3591	3734	4.0	2867	3113	8.6	1438	1543	7.3
POMERADO (1121125)	9070	8698	4.1	9094	8502	6.5	8634	8693	0.7	7243	8129	12.2
VIA PKWY (1121142)	3025	3012	0.4	3597	3733	3.8	2863	3102	8.3	1412	1528	8.2
VIA PKWY (1121147)	396	351	11.4	450	491	9.0	503	819	62.9	432	470	8.7
VIA PKWY (1121118)	4564	4324	5.3	5990	5827	2.7	6029	5879	2.5	5609	5402	3.7
VIA PKWY (1121112)	9313	8665	7.0	9515	8306	12.7	9054	8669	4.3	7440	8344	12.2
VIA PKWY (1121066)	8104	7920	2.3	8123	7398	8.9	7752	7884	1.7	6883	7691	11.7
VIA PKWY (1121154)	386	338	12.4	438	469	7.1	475	724	52.4	403	444	10.2
VIA PKWY (1121151)	2683	2954	10.1	3146	3538	12.5	2557	2848	11.4	1255	1228	2.2
El Norte Parkway (1108555)	1048	1100	4.9	997	696	30.2	940	833	11.4	757	666	12.0
El Norte Parkway (1100607)	265	185	1*	403	350	13.1	277	226	1*	188	186	1.0
Rancho Bernardo Road (1108539)	457	107	76.5	614	430	30.0	509	483	5.1	442	188	57.6
15 SB N/O Felicita (1125879)	6505	7763	19.3	6167	6716	8.9	5767	6839	18.6	6024	6376	5.8
(1125865)	6260	7151	14.2	5997	6457	7.7	5645	6932	22.8	5618	6735	19.9
15 NB N/O Felicita (1125886)	4315	4218	2.3	5239	5402	3.1	4997	5467	9.4	4881	4866	0.3
15 SB S/O Felicita (1125872)	4033	3873	4.0	5040	4943	1.9	4886	4855	0.6	4444	4389	1.2
HOV South of SR?78 (1123148)	150	187	1*	208	290	1*	259	390	1*	231	329	1*
15 NB HOV off SO 78 (1123159)	76	67	11.8	125	121	3.5	106	168	1*	68	85	1*
15 SB HOV S/O Camino (1122925)	2312	2170	6.2	2812	2750	2.2	2386	2292	3.9	1400	1381	1.4
HOV Valley Pkwy (1125321)	2434	2389	1.8	2947	2740	7.0	2202	2406	9.3	1020	876	14.2
15 SB HOV SO Rte 78 (1123155)	2402	2397	0.2	2872	2738	4.7	2155	2403	11.5	1001	872	12.9
HOV North of SR56 (1123014)	2439	2262	7.3	3133	2949	5.9	2888	2695	6.7	1746	1565	10.4
HOV North of SR56 (1123013)	460	315	1*	516	459	11.0	504	539	6.9	421	428	1.6
15 NB HOV Felicita (1125483)	230	259	12.5	343	416	1*	354	563	59.0	314	404	1*
15 SB HOV NO Felic (1125495)	1858	2257	21.5	2171	2599	19.7	1564	2339	49.5	960	837	12.8
15 NB HOV Citracado (1125486)	497	173	65.2	532	267	49.7	591	314	46.8	569	208	63.4
15 SB HOV S/O Felic (1125499)	2578	2994	16.1	3035	3556	17.2	2294	2852	24.3	1283	1222	4.7
15 NB HOV S/O Feli (1125491)	434	358	1*	522	517	1.0	568	772	35.9	471	486	3.2
15 SB HOV Center CT (1125503)	2782	2969	6.7	3415	3566	4.4	2697	2861	6.1	1325	1244	6.1
15 NB HOV S/O Mercy (1125292)	663	539	1*	776	776	0.1	753	799	6.2	577	612	6.1
15 SB HOV N/O Carrol (1125318)	2227	1974	11.3	2859	2560	10.5	2907	2477	14.8	1953	1745	10.6
15N HOV CARROLL CYN (1115829)	665	540	1*	825	803	2.6	723	819	13.3	507	489	3.6
South of SR?78 (1125265)	6869	6985	1.7	6284	6377	1.5	5759	5910	2.6	4491	4398	2.1
15 N SO Ca del Norte (1123030)	5436	5168	4.9	7282	7022	3.6	7562	7437	1.7	6414	6140	4.3
15 S SO Ca del Norte (1123006)	9227	9033	2.1	9734	9563	1.8	8336	9463	13.5	8263	8511	3.0
15 NB HOV S/O Camino (1122926)	484	514	6.3	575	810	40.8	566	1045	84.6	474	738	55.7
15 S HV NO Carmel Mt (1122967)	2440	2277	6.7	3175	2949	7.1	2842	2684	5.6	1722	1553	9.8
15 N NO Carmel Mtn (1123031)	8991	8872	1.3	9207	9231	0.3	7694	9199	19.6	7945	8415	5.9
15 N NO Carmel Mtn (1123029)	5260	5192	1.3	6998	7056	0.8	7144	7412	3.8	6147	6122	0.4
15 N HV NO Carmel Mt (1122962)	492	517	5.1	586	810	38.2	577	1046	81.2	484	736	52.0
North of SR?56 (1123003)	9486	9222	2.8	9801	9754	0.5	8543	9721	13.8	8567	9003	5.1
North of Poway Rd (1125303)	3071	2477	19.3	2975	3168	6.5	2571	3097	20.4	2367	2307	2.5
North of Poway Rd (1125299)	615	527	14.3	764	771	0.9	689	799	1*	538	623	15.8
HOV South of MercyRd (1125288)	2069	1892	8.5	2647	2585	2.3	2679	2473	7.7	1785	1724	3.4
15 SB HOV S/O Mir Rd (1125280)	2215	1591	28.2	2942	2268	22.9	2960	2135	27.9	2012	1530	24.0
HOV North of SR?163	725	734	1.2	898	1096	22.1	725	1011	39.5	417	499	1*
HOV South of SR?163	2710	1883	30.5	3520	2610	25.9	3360	2533	24.6	2770	1844	33.4
I-15 NB Bernardo Center Drive (1120994)	5219	4870	6.7	6899	6579	4.6	7355	7015	4.6	6386	6054	5.2
I-15 NB Ted Williams (1123002)	5844	5811	0.6	7969	8052	1.0	8120	8387	3.3	6809	6753	0.8

4.3.2 Delay, Speed and Bottleneck Comparisons

Below in Figures 4-1 and 4-2 the comparison of the Southbound and Northbound SB-MD-MI (Cluster 1) speed contours and bottlenecks. What can be seen here is that as expected for the AM the northbound has very little congestion while the southbound is heavily congested, more so than the typical day. Unlike the typical day results, which show the 5 minute speeds, these results have been summarize for every 15 minutes. For each figure the real world data is shown on top and the model results are shown below with key interchange names shown for locational perspective. The flow of direction is always left to right.

What these figures do show is that the model is able to do an acceptable job in representing the real world conditions in terms of bottleneck size, and duration as well as the overall reduction in speeds.

Time																																				
6:15 AM	67	63	62	65	59	63	61	65	64	64	62	64	66	65	66	65	65	64	64	65	64	65	67	61	66	70	66	65	67	67	66	63	67	67	70	67	70	76
6:30 AM	67	62	59	61	52	56	48	49	52	51	49	56	60	57	52	55	60	60	61	62	60	62	63	59	63	68	64	62	65	64	63	59	65	65	68	65	68	75
6:45 AM	66	60	49	43	28	34	35	40	29	32	42	56	62	59	58	58	57	58	62	61	59	62	61	58	58	59	55	56	61	63	62	62	65	64	66	64	66	74
7:00 AM	60	38	27	21	16	25	39	45	34	32	45	55	61	60	61	58	57	57	61	62	60	63	62	56	40	38	33	50	60	62	62	60	64	65	65	65	66	73
7:15 AM	33	18	22	29	18	28	46	53	50	50	50	54	57	53	53	50	54	53	58	61	59	62	57	54	28	30	27	48	58	61	62	62	64	64	64	64	66	73
7:30 AM	21	15	21	49	30	32	38	45	39	39	43	54	58	54	54	49	42	48	57	60	59	54	38	42	24	28	25	49	54	58	60	60	63	63	63	63	66	72
7:45 AM	21	18	26	50	21	29	42	47	41	38	38	47	45	37	44	47	49	48	55	43	41	37	34	37	25	30	30	50	51	59	60	61	63	63	62	63	65	72
8:00 AM	25	20	36	45	19	29	30	33	28	27	35	47	48	43	49	51	54	47	54	27	28	38	30	35	25	30	27	47	46	58	60	61	63	63	62	63	65	71
8:15 AM	36	27	33	30	14	27	27	37	35	31	37	54	59	58	59	57	55	46	49	23	26	32	27	33	24	28	25	47	53	59	60	62	64	64	64	63	66	73
8:30 AM	61	35	26	29	22	32	37	45	46	39	40	49	47	45	44	47	50	43	42	24	25	32	26	32	21	26	21	49	57	60	60	61	63	63	64	63	65	73
8:45 AM	67	60	52	44	21	28	27	32	27	26	33	47	46	41	42	48	54	49	48	22	24	27	20	23	16	19	16	57	61	63	62	62	65	64	65	63	66	72
9:00 AM	67	62	58	44	18	28	30	35	36	34	40	51	57	52	55	55	47	40	35	15	20	21	17	21	18	23	22	55	61	62	62	62	64	64	65	63	66	73
9:15 AM	68	62	60	56	34	34	41	49	52	54	55	59	62	60	55	45	24	26	29	20	22	28	27	36	27	30	26	48	57	59	61	60	63	62	64	62	66	73
9:30 AM	67	62	61	60	56	61	57	61	62	61	60	63	64	63	60	46	36	40	44	31	27	38	37	41	25	28	26	47	57	58	59	59	62	61	64	61	66	72
9:45 AM	67	62	61	61	59	67	59	63	62	63	61	63	65	64	64	61	60	59	59	55	47	48	45	47	26	29	26	46	57	57	58	59	61	61	65	61	66	72
10:00 AM	67	61	61	64	61	68	60	63	62	63	61	64	65	64	64	63	64	63	64	63	59	61	61	55	49	50	39	53	58	60	60	60	62	62	65	60	66	72

Del Norte | West Valley | Felicita Rd | Via Rancho | Pomerado Rd | Rancho Bernardo Rd | Camino del | Ted Williams Parkway | Mira Mesa Blvd | Miramar Rd | Split I-15 / SR-163

Time																																				
6:15 AM	74	58	60	53	53	59	45	49	59	51	61	68	72	72	71	65	73	70	72	67	64	67	69	63	69	68	70	75	63	69	73	75	73	74	73	74	75	74
6:30 AM	73	56	46	49	32	38	45	51	44	35	58	67	72	72	72	63	73	71	71	66	62	67	58	60	69	67	69	75	59	67	72	74	73	73	69	73	74	74
6:45 AM	72	52	36	43	26	30	40	47	35	33	56	67	72	71	71	61	72	69	71	64	60	64	48	58	69	66	67	75	56	67	69	74	72	72	61	72	73	73
7:00 AM	70	35	39	55	39	34	33	44	33	32	55	67	72	71	71	60	72	67	70	60	56	62	39	58	68	61	58	75	54	67	67	73	71	72	61	70	72	72
7:15 AM	71	27	41	53	65	62	33	47	37	34	56	66	71	71	71	58	71	66	69	47	44	57	26	57	65	50	41	75	54	65	64	72	71	72	59	69	72	72
7:30 AM	69	33	38	53	54	56	45	60	51	42	60	67	71	71	71	59	71	63	68	29	31	31	20	57	62	43	38	74	54	66	63	70	70	70	53	66	70	71
7:45 AM	69	19	40	46	27	24	48	65	68	62	67	70	73	72	72	60	73	67	71	18	23	23	21	57	66	50	40	74	54	65	62	68	70	70	53	64	69	71
8:00 AM	56	22	31	19	17	22	37	55	55	44	62	68	72	72	71	57	72	66	71	26	26	27	22	56	62	46	40	74	53	65	61	69	70	70	50	62	66	70
8:15 AM	74	29	29	31	19	23	34	50	45	36	58	63	69	71	71	51	72	66	71	31	30	30	22	56	42	39	39	74	53	65	62	72	70	71	55	66	68	71
8:30 AM	75	69	29	25	20	22	27	48	36	34	57	66	71	71	70	47	72	62	71	39	38	31	22	56	34	37	37	70	55	64	60	73	71	72	56	69	69	71
8:45 AM	75	72	29	17	19	19	24	46	34	33	56	66	71	71	70	46	70	63	71	50	46	37	24	56	28	27	22	72	57	69	63	73	72	73	62	71	72	72
9:00 AM	75	73	37	18	18	19	24	44	32	33	56	63	69	70	70	48	71	67	71	54	51	49	27	32	22	22	23	70	55	65	61	73	72	72	59	71	72	72
9:15 AM	75	74	67	28	19	20	24	42	34	32	54	59	69	70	70	50	73	67	72	64	62	52	20	23	29	34	32	69	56	64	61	73	72	73	62	70	72	73
9:30 AM	75	74	72	64	29	29	25	43	42	38	55	63	69	70	70	54	72	68	71	64	63	65	50	35	32	36	35	51	55	66	60	73	72	73	67	71	72	73
9:45 AM	75	73	72	67	61	54	30	48	59	56	62	60	68	70	70	61	72	69	70	61	61	64	60	49	36	38	36	67	54	65	61	72	71	71	62	68	70	72
10:00 AM	75	74	73	68	69	66	54	58	62	58	66	68	71	72	72	66	73	71	72	67	67	66	66	59	49	45	39	71	54	64	63	72	71	71	65	70	70	72

Figure 4-1: 15-minute Southbound Speed Contours Real versus Modeled SB-MD-MI [Source: TSS]

Time																																				
6:15 AM	66	66	66	66	65	68	66	66	65	66	69	67	67	70	67	64	65	63	65	66	64	66	67	65	67	68	68	64	66	71	68	70	65	65	68	68	68
6:30 AM	64	64	64	66	63	67	65	64	63	65	68	66	65	69	67	64	65	63	66	64	65	66	68	65	67	68	68	64	65	70	67	69	64	63	66	69	69
6:45 AM	63	63	63	65	63	66	64	64	63	65	67	65	62	68	65	63	64	62	65	64	66	66	68	66	67	68	68	64	64	69	67	68	65	64	68	69	69
7:00 AM	62	62	62	65	63	65	64	64	63	65	67	66	64	68	66	63	65	63	66	63	66	66	67	66	68	69	68	65	65	70	68	68	64	64	68	69	69
7:15 AM	61	61	61	64	63	65	65	64	62	65	66	65	60	66	65	63	65	63	66	62	66	66	67	65	67	68	67	64	63	70	67	69	65	66	66	69	69
7:30 AM	62	62	62	64	64	65	65	64	62	65	66	66	60	65	65	62	64	62	66	64	66	66	66	65	67	68	67	61	65	69	67	67	63	63	63	69	69
7:45 AM	63	63	63	65	64	65	65	64	62	65	66	65	63	66	65	63	64	63	67	65	66	67	67	65	67	68	67	64	65	69	66	66	62	48	62	69	69
8:00 AM	63	63	63	65	64	65	64	64	63	65	65	65	61	65	65	62	63	61	66	64	65	66	67	66	67	67	67	64	64	69	66	66	61	45	61	69	69
8:15 AM	63	63	63	64	63	65	64	64	62	65	66	65	60	67	65	62	63	61	66	64	64	66	67	65	67	68	66	61	63	69	65	66	61	40	61	69	69
8:30 AM	63	63	63	64	63	66	64	63	62	64	66	64	62	65	64	61	63	61	65	64	63	65	65	52	66	67	66	63	64	68	65	67	62	49	61	68	68
8:45 AM	63	63	63	64	63	66	64	63	61	64	66	64	61	65	64	62	63	61	65	64	63	64	65	48	65	66	66	62	61	67	63	66	58	52	59	68	68
9:00 AM	62	62	62	64	63	64	58	63	61	63	65	64	62	66	64	61	63	60	64	62	63	64	65	57	64	65	64	61	61	66	63	66	60	57	60	68	67
9:15 AM	64	64	64	65	62	66	62	62	61	63	67	63	63	67	64	62	64	60	63	61	62	62	63	61	63	64	62	60	58	66	62	67	59	58	59	68	67
9:30 AM	65	65	65	65	62	66	62	61	60	62	66	62	63	66	63	62	63	59	63	61	62	62	63	62	65	64	63	61	59	66	63	67	59	58	58	68	67
9:45 AM	65	65	65	65	63	67	64	63	62	63	66	63	64	67	64	62	63	59	63	60	63	63	63	62	64	64	62	60	58	66	63	67	59	60	59	68	67
10:00 AM	65	65	65	65	63	67	63	62	61	63	67	64	60	67	64	60	64	60	64	60	63	63	64	63	65	65	62	61	60	67	64	67	59	59	57	67	67

Time	Merge I-15 / SR-163				Miramar Rd				Mira Mesa Blvd				Ted Williams				Camino Del				Rancho				Pomerado Rd				Via Rancho				Felicita Rd				West Valley				Del Norte			
6:15 AM	72	68	69	60	69	66	73	73	72	74	75	74	75	75	75	76	76	72	75	74	75	72	74	76	76	75	75	76	75	75	75	75	74	74	76	76	76
6:30 AM	58	58	62	55	67	60	70	71	70	72	74	74	74	75	75	76	75	71	74	73	74	69	74	76	76	74	74	76	74	75	75	75	74	72	76	76	76
6:45 AM	68	57	60	52	64	57	68	67	67	72	74	73	73	73	75	76	75	67	74	70	72	64	72	75	75	73	73	76	73	74	74	74	72	68	76	76	75
7:00 AM	65	59	58	52	62	52	63	66	65	71	73	72	73	72	74	75	75	67	73	69	73	62	72	75	75	73	73	76	73	74	74	74	72	68	76	76	75
7:15 AM	70	62	60	51	61	54	64	64	64	70	72	72	72	72	74	75	74	64	73	65	71	61	72	75	74	72	72	75	72	74	74	74	71	70	76	76	76
7:30 AM	65	61	58	48	61	51	64	62	63	70	72	71	72	72	74	75	74	62	72	63	70	58	71	74	75	72	71	75	71	73	73	74	69	69	75	76	75
7:45 AM	65	60	51	47	53	51	56	50	60	67	70	70	71	72	74	74	74	60	72	61	70	56	71	75	75	73	72	75	71	73	74	74	70	69	76	76	75
8:00 AM	68	60	45	47	45	50	50	48	58	68	68	68	70	69	73	72	73	55	69	54	67	55	71	75	74	72	72	75	71	73	73	74	68	70	76	76	76
8:15 AM	70	66	55	51	51	48	50	50	60	67	68	68	70	70	73	71	73	57	69	53	68	56	70	74	74	72	71	75	70	73	73	74	66	70	75	76	75
8:30 AM	69	66	60	51	59	52	63	54	61	68	71	68	70	70	73	72	73	56	67	52	66	50	70	74	72	71	71	75	71	73	73	74	69	69	75	76	75
8:45 AM	71	70	67	54	64	56	65	55	61	69	71	70	71	70	74	73	73	60	70	54	68	53	70	29	63	70	70	75	74	75	75	75	73	72	75	76	75
9:00 AM	70	66	66	52	64	54	66	62	64	70	72	70	72	72	74	74	74	63	72	61	70	59	72	38	62	57	58	73	64	65	70	70	56	61	74	75	75
9:15 AM	73	70	70	55	66	61	68	65	66	70	73	71	72	71	74	74	74	63	72	60	70	60	72	75	75	73	72	75	72	74	73	73	50	62	74	75	75
9:30 AM	73	71	71	55	67	63	70	69	68	71	74	72	73	73	74	75	74	67	73	64	71	63	72	75	74	72	72	75	72	74	74	74	71	69	75	75	75
9:45 AM	73	72	72	60	68	65	72	70	70	72	73	72	73	74	74	75	74	66	72	65	71	60	71	74	74	71	72	75	72	74	73	74	71	67	75	75	75
10:00 AM	73	72	72	62	68	67	73	71	70	73	74	73	74	74	75	75	75	68	73	66	72	61	72	75	74	72	72	75	72	74	74	74	71	68	75	75	75

Figure 4-2: 15-minute Northbound Speed Contours Real versus Modeled SB-MD-MI [Source: TSS]

4.4 Calibration Results for Baseline – Cluster SB-MD-MI (2/09/2015)

As explained early in the process the Cluster models were developed starting from the calibrated typical day model. The second cluster took place between 6:00am and 10:00am and was generated due to a congestion event that started at 7:49 am milepost 31.35 in the southbound direction, and was built off of the AM typical day. The congestion event was the result of the congestion associated with the 1 lane blockage from Caltrans event 899879, which blocked lanes 3, 4 from 7:28 am to 7:45 and the 1 lane from 7:45 to 8:51 am at milepost 30.2, which is near the 9th avenue interchange with I-15 in Escondido. During the simulation there were 3 other Caltrans events on the I-15 one southbound event and 2 northbound events, one of which was outside of the network boundaries. Table 4-17 shows the details of the 5 events within the corridor.

Associated with the congestion event – ID 754666 was a triggered response plan that activated at 7:59 AM and was in place for an hour and five minutes till 9:04 AM. This response plan had one diversion route that used 8 signals. The diversion route assigns people travelling on SR-78 EB who normally take I-15 SB to continue on SR-78 to Center City Parkway and to enter I-15 SB using the Valley Parkway on-ramp. Table 4-18 shows the Signals that were selected by the DSS for the response plan and the time plan that was implemented.

Table 4-17: SB-MD-MI DSS and Caltrans Event Details

Event Type	Direction	ID	StartTime	Duration	EndTime	LinkID location	Blockage	Mile Post Incident
DSS - Congestion	SB	754666	7:49	1:05	8:54	28859	-	31.35
Caltrans Mainline	SB	899879	7:28	0:17	7:45	2262684	#3,4	30.2
Caltrans Mainline	SB	899879	7:45	1:06	8:51	2262684	#4	30.2
Caltrans Mainline	SB	899915	9:19	0:13	9:32	30789	-	27.2
Caltrans HOV	NB	899900	8:20	0:24	8:44	2279562	#2 HOV	2
Caltrans Mainline	NB	899918	9:13	0:39	9:52	2262618	Shoulder	24.05

Table 4-18: SB-MD-MI Signalized Intersection Response Plan Data

Device ID	Location	Plan Implemented
Caltrans.140	I-15 SB at Valley Road	7A
Caltrans.141	I-15 NB at Valley Road	7A
Escondido.100	Center City at Valley Road	3A
Escondido.17	Gateway at Valley Road	1A
Escondido.40	Center City at Mission Ave	3A
Escondido.58	Center City at Washington Ave	3A
Escondido.91	La Terraza at Valley Road	6A
Escondido.94	Tulip St at Valley Road	6A
Escondido.97	Quince at Valley Road	3A

4.4.1 Link Count Comparisons

Although the calibration target was for counts greater than 2000, in order to show a goodness of fit of the model the ramp counts were also included as part of the totally summary calibration results as well as the R^2 and slope. Table 4-19 shows the summary of the calibration targets noting that both the Flows over 2000 and the sum of all flows (the two calibration target fields) are well above the guidelines.

Table 4-19: SB-MD-MI (2/9/2015) Flow Calibration Summary

Type	Target	Criteria	6:00	7:00	8:00	9:00
Flows <750	< 15% or < 150 veh/hr	>75%	68.2%	79.6%	79.3%	91.0%
750 <Flows < 2000	< 15%	>75%	42.9%	80.6%	77.4%	78.9%
Flows > 2000	< 15%	>85%	95.2%	91.8%	93.0%	88.6%
All Flows	< 15%	>85%	80.0%	89.3%	88.8%	91.6%
Σ Flows	< 5%	<5%	1.1%	0.8%	0.3%	1.6%
R2			0.99	0.99	0.99	0.98
Slope			0.98	1.01	1.01	1.04

Tables 4-20 through 4-22 show the hourly details for the flow calibration results. It should be noted that counts that were less than 750 veh/hr were deemed valid if either the <15% difference or absolute difference is <150 (shown with a 1* in the tables) criteria were met.

Table 4-20: SB-MD-MI (2/9/2015) Flow Calibration Details (part 1)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
El Norte Parkway (1108554)	6131	5536	9.7	4898	4999	2.1	4976	4630	7.0	4068	3635	10.6
El Norte Parkway (1119743)	1654	1436	13.2	1857	1751	5.7	2220	2044	7.9	2331	2132	8.6
56 EB TO 15 NB (1122282)	467	725	55.2	1061	1150	8.4	1072	1078	0.6	870	882	1.4
TED WILLIAMS PKWY (1122762)	1380	1281	7.2	1535	1683	9.6	1504	1561	3.8	1124	1016	9.6
15 NB HOV N/O (1122502)	224	245	9.6	352	403	14.5	380	513	1*	306	383	1*
Miramar Way (1113862)	293	486	65.8	418	473	13.1	226	271	1*	180	255	1*
Carrroll Canyon Road (1108439)	6237	6763	8.4	8251	8608	4.3	8462	8644	2.1	6845	6871	0.4
Carrroll Canyon Road (1113478)	562	969	72.4	1351	1306	3.3	1235	1145	7.3	710	666	6.3
Carroll Canyon Road (1108440)	138	185	1*	378	296	1*	331	308	6.9	274	207	1*
S/O Mercy Road (1115838)	9900	10116	2.2	11301	11397	0.8	11227	11917	6.1	9465	11372	20.1
Valley Parkway (1108773)	4617	3826	17.1	4856	4419	9.0	4642	4321	6.9	5023	4182	16.7
Valley Parkway (1108774)	219	357	1*	421	374	11.1	433	460	6.3	580	547	5.7
Valley Parkway (1108556)	7259	6299	13.2	5502	5545	0.8	6178	5697	7.8	5614	5474	2.5
Auto Park Way/9th Avenue (1100601)	110	228	1*	195	385	97.6	264	443	1*	231	513	122.0
Auto Park Way/9th Avenue (1108772)	264	408	1*	448	419	6.4	356	345	3.0	332	380	14.3
Auto Park Way/9th Avenue (1113647)	240	333	1*	727	588	19.1	625	653	4.5	397	427	7.6
Auto Park Way/9th Avenue (1108771)	4221	3802	9.9	5178	4744	8.4	5018	4775	4.8	4779	4458	6.7
9th Avenue (1108558)	6340	6308	0.5	4690	5232	11.6	5661	5695	0.6	5236	5329	1.8
9th Avenue (1108559)	311	504	62.1	837	791	5.5	657	884	34.5	615	738	1*
Citricado Parkway (1100598)	114	175	1*	365	180	50.7	324	183	1*	412	274	1*
Citricado Parkway (1113644)	7	45	542.9	52	116	1*	56	139	1*	47	86	1*
Citricado Parkway (1108769)	4303	3872	10.0	5468	4871	10.9	5337	4942	7.4	4879	4507	7.6
Citricado Parkway (1108770)	213	312	46.3	492	482	2.0	405	468	15.5	352	381	8.3
Citricado Parkway (1108516)	7006	6218	11.3	5752	4881	15.1	6196	5809	6.3	5797	5683	2.0
Citricado Parkway (1108517)	212	309	1*	460	813	76.8	304	572	88.2	159	241	1*
Center City Parkway N/O I-15 (1119438)	186	289	1*	561	714	27.3	659	863	30.9	575	659	14.6
Centre City Parkway (1108545)	7237	6586	9.0	6405	5618	12.3	6455	6424	0.5	6192	5994	3.2
Centre City Parkway (1108546)	765	1126	47.2	1437	1505	4.7	1280	1215	5.1	756	745	1.4
Via Rancho Parkway (1108768)	175	243	1*	461	419	9.2	384	443	1*	349	348	0.4
Via Rancho Parkway (1108767)	4275	3907	8.6	5486	5202	5.2	5522	5365	2.8	4995	4848	2.9
Via Rancho Parkway (1113503)	263	359	1*	568	577	1.5	763	702	8.0	788	810	2.8
Via Rancho Parkway (1108543)	7898	7309	7.5	7462	6864	8.0	7236	7323	1.2	6453	6131	5.0
Via Rancho Parkway (1108544)	950	1538	61.9	1794	1949	8.7	1590	1707	7.4	1031	1066	3.4
Pomerado Road (1100578)	222	158	1*	567	179	68.5	495	329	33.5	360	462	1*
Pomerado Road (1108563)	190	272	1*	530	497	6.3	510	533	4.4	469	434	7.5
Pomerado Road (1108562)	4280	4028	5.9	5424	5282	2.6	5641	5518	2.2	5224	5238	0.3
Pomerado Road (1108541)	8815	8656	1.8	8448	8625	2.1	8223	8716	6.0	7077	6792	4.0
Pomerado Road (1100524)	35	71	1*	115	108	5.9	142	132	6.8	117	135	15.6
Rancho Bernardo Road (1100575)	715	1137	59.0	1357	1376	1.4	1534	1743	13.6	1121	980	12.6
Rancho Bernardo Road (1108595)	4160	3985	4.2	5295	5114	3.4	5469	5241	4.2	4999	4984	0.3
Rancho Bernardo Parkway (1108596)	132	177	1*	225	280	1*	285	330	1*	305	316	3.5
Rancho Bernardo Road (1108538)	7688	7839	2.0	7500	7995	6.6	7152	7681	7.4	6224	6338	1.8
Rancho Bernardo Road (1108540)	294	443	1*	690	643	6.9	666	567	14.8	499	482	3.5
Rancho Bernardo Parkway (1108594)	123	169	1*	317	276	12.9	362	340	6.0	310	300	3.2
Rancho Bernardo Road (1107611)	350	559	59.7	858	909	5.9	1079	1155	7.0	812	873	7.5
Bernardo Center Drive (1100571)	218	302	1*	519	433	1*	650	615	5.4	379	300	1*
Bernardo Center Drive (1108598)	125	177	1*	346	355	2.7	424	393	7.4	311	360	15.7
Bernardo Center Drive (1108597)	3590	3374	6.0	4551	4284	5.9	4637	4467	3.7	4235	4121	2.7
Bernardo Center Drive (1108519)	7875	8026	1.9	7992	8543	6.9	7409	8013	8.1	6786	6749	0.5
Bernardo Center Drive (1108520)	131	298	127.8	361	513	42.0	337	548	62.5	261	500	91.5
Bernardo Center Drive (1107608)	279	526	88.4	858	938	9.3	1157	1285	11.1	868	998	15.0
Camino Del Norte (1100568)	370	560	51.4	813	833	2.4	727	862	1*	683	706	3.3
Camino Del Norte (1108593)	199	256	1*	428	339	1*	440	328	1*	315	340	7.8
Camino Del Norte (1113936)	492	823	67.3	1109	1199	8.1	1151	1273	10.6	749	859	14.7
Camino Del Norte (1108592)	4219	4200	0.4	5676	5586	1.6	6213	6087	2.0	5454	5356	1.8

Table 4-21: SB-MD-MI (2/9/2015) Flow Calibration Details (part 2)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
Camino Del Norte (1108426)	566	802	41.7	1168	1031	11.8	1333	1159	13.0	1061	901	15.1
Camino Del Norte (1108425)	7710	7731	0.3	8002	8213	2.6	7062	7715	9.2	6466	6585	1.8
Carmel Mountain Road (1108591)	206	300	1*	580	549	5.3	641	613	4.4	403	473	1*
Carmel Mountain Road (1108590)	4824	4774	1.0	6516	6296	3.4	6912	6702	3.0	5870	5710	2.7
Carmel Moutain Road (1108427)	8363	8512	1.8	8720	8914	2.2	8019	8771	9.4	7245	7359	1.6
Ted Williams Parkway (1108589)	66	112	1*	217	225	3.7	321	256	1*	141	174	1*
EB SR-56 (1113996)	326	512	57.1	999	1076	7.7	1137	1210	6.5	889	904	1.7
Ted Williams Parkway (1113985)	4858	4931	1.5	6364	6327	0.6	6648	6619	0.4	5648	5567	1.4
Ted Williams Parkway (1108429)	7226	7516	4.0	7646	7736	1.2	7737	7347	5.0	6552	7180	9.6
Ted Williams Parkway (1108430)	413	576	39.5	778	919	18.1	787	763	3.0	758	575	24.2
Rancho Penasquitos (1100560)	71	100	1*	164	182	11.2	186	129	1*	178	87	1*
Poway/Rancho Penasquitos (1113932)	341	560	64.2	946	958	1.2	970	1087	12.1	781	928	18.8
Rancho Penasquitos (1108490)	618	854	38.2	932	718	22.9	925	714	22.8	899	710	1*
Rancho Penasquitos (1108488)	523	802	53.3	951	1191	25.3	951	1218	28.1	808	868	7.4
Poway/Rancho Penasquitos (1108585)	5296	5392	1.8	6762	7076	4.6	7101	7097	0.1	6031	5958	1.2
Poway/Rancho Penasquitos (1108586)	165	225	1*	451	301	1*	418	444	6.3	299	402	1*
Mercy Road (1108718)	331	488	47.4	883	946	7.2	840	984	17.1	666	728	9.3
Mercy/Scripps Poway (1108717)	5340	5498	3.0	6885	7104	3.2	7242	7200	0.6	6196	6128	1.1
Mercy Road (1108450)	8900	8905	0.1	9755	9748	0.1	9692	9869	1.8	8541	9841	15.2
Mercy Road (1108451)	622	1000	60.8	1225	1240	1.2	1215	1192	1.9	1018	981	3.6
S/O Mercy Road (1115749)	6320	6387	1.1	8372	8427	0.7	8343	8346	0.0	6954	6823	1.9
Mira Mesa Boulevard (1100553)	420	744	77.0	860	1031	19.9	1007	1028	2.1	1020	1214	19.0
Mira Mesa Boulevard (1108492)	279	406	1*	875	903	3.2	725	710	2.1	391	318	1*
Mira Mesa Boulevard (1108491)	8633	9325	8.0	9576	10365	8.2	9305	10884	17.0	7895	10179	28.9
Mira Mesa Boulevard (1108500)	106	144	1*	292	302	3.5	263	287	9.3	224	242	8.1
Mira Mesa Boulevard (1108416)	315	487	54.7	764	833	9.0	727	823	13.2	620	612	1.4
Mira Mesa Boulevard (1108415)	5585	5850	4.8	7352	7379	0.4	7521	7304	2.9	6139	6040	1.6
Mira Mesa Boulevard (1108493)	573	854	49.0	1627	1869	14.9	1317	1175	10.8	998	975	2.3
Mira Mesa Boulevard (1100504)	515	1058	105.4	1134	1502	32.5	1216	1661	36.6	925	1079	16.6
N/O Carroll Canyon Road (1115739)	6566	6934	5.6	8843	8894	0.6	9036	8953	0.9	7364	7094	3.7
Carroll Canyon Road (1100542)	310	447	1*	774	709	8.4	772	918	18.9	581	1038	78.7
Carroll Canyon Road (1108148)	9001	9908	10.1	10887	12270	12.7	10164	11830	16.4	8418	10352	23.0
Carroll Canyon Road (1108518)	278	412	1*	868	831	4.2	609	475	1*	456	411	10.0
Miramar Road (1108495)	9035	9348	3.5	11307	11723	3.7	10387	11205	7.9	8272	9680	17.0
Miramar Road (1108496)	441	584	1*	921	862	6.4	918	848	7.6	609	616	1.1
Miramar Road (1100549)	664	884	33.2	1339	1344	0.4	1247	1147	8.1	1032	1107	7.2
Miramar Road (1108494)	194	244	1*	535	465	13.1	600	438	27.1	600	596	0.7
Miramar Road (1120168)	147	256	1*	345	361	4.6	379	428	12.9	421	497	1*
Miramar Road (1120614)	785	1194	52.1	1126	1208	7.3	1106	1062	3.9	1099	1160	5.5
Miramar Road (1120167)	6900	7401	7.3	9268	9432	1.8	9308	8996	3.3	7067	6941	1.8
S/O Miramar Road (1115820)	8325	8689	4.4	10542	10864	3.1	10088	9156	9.2	8142	9092	11.7
Miramar Way (1108537)	26	19	1*	53	30	1*	51	41	1*	60	13	78.0
Miramar Way (1108536)	8313	8608	3.5	10445	10649	2.0	10382	9958	4.1	8148	8039	1.3
Miramar Way (1108607)	8417	8625	2.5	10995	11066	0.6	10492	9420	10.2	8226	9382	14.1
Miramar Way (1108608)	48	57	1*	84	74	12.4	84	86	2.6	138	130	5.8
Miramar Way (1100498)	496	880	77.5	870	827	5.0	591	499	1*	404	282	1*
N/O NB I-15/163 Merge (1115721)	9163	9557	4.3	11222	11583	3.2	10832	10401	4.0	8483	8301	2.2
SB 15 @ CENTRE CITY (1119756)	5533	5753	4.0	5131	5778	12.6	4875	4664	4.3	3819	3846	0.7
NB 15 @ CENTRE CITY (1119749)	1851	1641	11.3	2040	1955	4.2	2432	2262	7.0	2540	2306	9.2
15 NB N/O Poway Rd (1122487)	5530	5682	2.7	7237	7493	3.5	7525	7686	2.1	6375	6427	0.8
15 SB N/O Carrol Cyn (1122479)	9876	10071	2.0	11945	12446	4.2	11170	12114	8.5	9079	10788	18.8
MIRAMAR RD (1122272)	8695	9247	6.3	11009	11634	5.7	10344	11132	7.6	8242	9638	16.9
15 NB S/O Miramar Rd (1122469)	7174	8013	11.7	8610	10009	16.3	8514	9388	10.3	6995	7495	7.1
SB 15 @AMMO RD (1117899)	8334	8640	3.7	10916	11081	1.5	10340	9505	8.1	8284	9444	14.0
Valley Parkway (1108557)	144	213	1*	258	244	5.5	271	357	1*	323	296	8.2
Pomerado Road (1108542)	136	139	2.4	305	276	9.4	251	250	0.4	191	124	1*
Poway/Rancho Penasquitos (1108587)	31	82	1*	111	124	11.7	118	142	1*	87	51	1*
Miramar Road (1108455)	36	7	1*	143	17	1*	88	18	1*	94	5	1*
Valley Parkway (1100604)	455	751	65.1	721	933	29.4	888	1156	30.2	865	761	12.0
BERNARDO CTR (1121044)	437	298	1*	546	436	1*	551	542	1.6	491	412	1*
Bernardo Ctr (1121037)	4483	4387	2.1	5860	5756	1.8	6223	6049	2.8	5505	5548	0.8

Table 4-22: SB-MD-MI (2/9/2015) Flow Calibration Details (part 3)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	6:00-7:00			7:00-8:00			8:00-9:00			9:00-10:00		
Bernardo Ctr (1121052)	373	355	4.7	467	537	14.9	453	656	44.9	472	485	2.7
Bernardo Ctr (1121051)	2586	2526	2.3	3123	3279	5.0	2580	2657	3.0	1311	1308	0.2
Bernardo Ctr (1121038)	8460	8349	1.3	8875	8959	0.9	8403	8638	2.8	7284	7004	3.8
RCH BERN (1121168)	400	357	10.9	494	548	10.9	480	675	40.6	495	508	2.5
RCH BERN (1121165)	2550	2562	0.5	3083	3309	7.3	2573	2674	3.9	1276	1327	4.0
RCH BERN (1121034)	8958	9075	1.3	8896	9406	5.7	8726	9453	8.3	7361	7308	0.7
Green Vly Ck (1121099)	4345	4253	2.1	5606	5602	0.1	5787	5856	1.2	5367	5500	2.5
Green Vly Ck (1121135)	352	224	1*	440	327	1*	434	399	8.1	446	298	1*
Green Vly Ck (1121138)	2811	2907	3.4	3552	3732	5.1	3029	3095	2.2	1422	1546	8.7
Green Vly Ck (1121105)	9024	8773	2.8	8758	8894	1.6	8578	8984	4.7	7342	6969	5.1
POMERADO (1121131)	4312	4106	4.8	5498	5396	1.8	5705	5646	1.0	5272	5378	2.0
POMERADO (1121161)	364	349	4.1	476	522	9.7	472	610	29.3	489	425	13.1
POMERADO (1121158)	2813	2931	4.2	3516	3729	6.1	3013	3082	2.3	1419	1540	8.5
POMERADO (1121125)	9019	8778	2.7	8711	8902	2.2	8515	8977	5.4	7322	6935	5.3
VIA PKWY (1121142)	2882	2947	2.3	3544	3724	5.1	3007	3065	1.9	1399	1527	9.1
VIA PKWY (1121147)	358	351	1.8	475	518	9.1	484	612	26.4	488	425	12.9
VIA PKWY (1121118)	4620	4282	7.3	5988	5775	3.6	6221	6056	2.6	5739	5668	1.2
VIA PKWY (1121112)	9206	8815	4.2	9214	8813	4.3	8740	9047	3.5	7494	7224	3.6
VIA PKWY (1121066)	8204	7594	7.4	7658	7196	6.0	7500	7671	2.3	6919	6752	2.4
VIA PKWY (1121154)	345	339	1.6	444	496	11.7	463	583	1*	446	396	11.2
VIA PKWY (1121151)	2501	2931	17.2	3089	3555	15.1	2697	2927	8.5	1243	1156	7.0
El Norte Parkway (1108555)	639	1205	88.5	952	678	28.8	931	906	2.7	761	740	2.7
El Norte Parkway (1100607)	149	206	1*	482	503	4.3	428	333	1*	194	226	1*
Rancho Bernardo Road (1108539)	288	66	77.1	618	317	48.8	561	401	28.6	479	155	67.6
15 SB N/O Felicita (1125879)	7032	6809	3.2	5565	6014	8.1	6360	6533	2.7	5965	6124	2.7
(1125865)	6686	6569	1.8	5343	5650	5.7	5650	6405	13.4	5570	5957	7.0
15 NB N/O Felicita (1125886)	4360	4175	4.2	5326	5347	0.4	5485	5408	1.4	4987	4885	2.0
15 SB S/O Felicita (1125872)	4012	3825	4.7	5163	4888	5.3	5038	4950	1.8	4577	4539	0.8
HOV South of SR?78 (1123148)	152	179	1*	201	286	1*	252	361	1*	220	306	1*
15 NB HOV off SO 78 (1123159)	44	63	1*	148	115	1*	128	150	1*	65	83	1*
15 SB HOV S/O Camino (1122925)	2277	2051	9.9	2829	2780	1.7	2508	2387	4.8	1224	1350	10.3
15 SB HOV SO Rte 78 (1123155)	2737	2541	7.1	2867	2699	5.9	2716	2373	12.6	1121	798	28.8
HOV North of SR56 (1123014)	2349	2191	6.7	3215	2999	6.7	2991	2712	9.3	1408	1521	8.0
HOV North of SR56 (1123013)	443	313	1*	520	448	13.9	532	507	4.8	456	424	6.9
15 NB HOV Felicita (1125483)	239	249	4.0	331	407	1*	394	512	1*	305	380	1*
15 SB HOV NO Felic (1125495)	1998	2443	22.3	2196	2625	19.5	2277	2323	2.0	928	733	21.1
15 SB HOV S/O Felic (1125499)	2376	2967	24.9	2691	3577	32.9	2437	2920	19.8	1286	1148	10.8
15 NB HOV S/O Feli (1125491)	405	355	12.2	549	532	3.1	551	622	12.9	506	433	14.3
15 SB HOV Center CT (1125503)	2597	2944	13.4	3316	3576	7.8	2812	2945	4.7	1284	1162	9.5
15 NB HOV S/O Mercy (1125292)	632	524	1*	809	748	7.5	787	770	2.2	639	619	3.2
15 SB HOV N/O Carrol (1125318)	2125	1929	9.2	3012	2488	17.4	2942	1009	65.7	1591	1437	9.7
15N HOV CARROLL CYN (1115829)	630	554	12.1	848	797	6.0	796	827	3.9	551	502	9.0
South of SR?78 (1125265)	6975	6156	11.7	5735	5955	3.8	5938	5775	2.8	4340	4275	1.5
15 N SO Ca del Norte (1123030)	5126	5050	1.5	7147	6802	4.8	7613	7338	3.6	6369	6203	2.6
15 S SO Ca del Norte (1123006)	10251	9037	11.8	11125	9804	11.9	10086	9368	7.1	9112	7751	14.9
15 NB HOV S/O Camino (1122926)	442	513	1*	583	787	34.9	594	963	62.2	514	727	41.5
15 S HV NO Carmel Mt (1122967)	2359	2202	6.6	3199	2996	6.4	2985	2710	9.2	1372	1505	9.7
15 N NO Carmel Mtn (1123031)	8602	8819	2.5	9220	9457	2.6	8522	9203	8.0	7671	7662	0.1
15 N NO Carmel Mtn (1123029)	4891	5069	3.6	6774	6837	0.9	7182	7322	1.9	6118	6182	1.1
15 N HV NO Carmel Mt (1122962)	484	514	6.3	589	789	34.0	604	962	59.2	539	725	34.5
North of SR?56 (1123003)	9183	9162	0.2	10003	9961	0.4	9465	9754	3.1	8094	8152	0.7
North of Poway Rd (1125303)	3166	2412	23.8	3011	3243	7.7	2918	2968	1.7	2540	2193	13.7
North of Poway Rd (1125299)	587	512	12.7	782	744	4.8	797	771	3.3	571	624	9.2
HOV South of MercyRd (1125288)	2135	1824	14.6	3008	2465	18.1	2957	1047	64.6	1542	1423	7.7
15 SB HOV S/O Mir Rd (1125280)	2077	1982	4.6	3024	2726	9.9	2964	1196	59.6	1658	1529	7.8
HOV North of SR?163	669	729	8.9	919	1069	16.3	795	1010	27.0	446	515	1*
HOV South of SR?163	2636	2432	7.7	3670	3335	9.1	3492	3300	5.5	2422	2427	0.2
I-15 NB Bernardo Center Drive (1120994)	5105	4759	6.8	6826	6363	6.8	7482	6924	7.5	6455	6178	4.3
I-15 NB Ted Williams (1123002)	6414	5653	11.9	8818	7756	12.0	9372	8249	12.0	7882	6777	14.0

4.4.2 Delay, Speed and Bottleneck Comparisons

Below in Figures 4-3 and 4-4 the comparison of the Southbound and Northbound SB-MD-MI (Cluster 2-2/9/2015) speed contours and bottlenecks. What can be seen here is that as expected for the AM the northbound has very little congestion while the southbound is heavily congested, more so than the typical day. Unlike the typical day results, which show the 5 minute speeds, these results have been summarize for every 15 minutes. For each figure the real world data is shown on top and the model results are shown below with key interchange names shown for locational perspective. The flow of direction is always left to right.

What these figures do show is that the model is able to do an acceptable job in representing the real world conditions in terms of bottleneck size, and duration as well as the overall reduction in speeds.

Time																																					
6:15 AM	66	63	62	55	53	69	63	66	64	65	63	66	67	66	66	65	66	52	66	65	53	66	66	64	55	69	49	54	65	57	55	56	67	56	67	55	67	74
6:30 AM	65	61	58	52	50	65	57	61	55	56	52	61	65	63	63	62	60	46	61	63	52	63	64	62	53	68	47	51	63	54	52	54	65	54	66	53	66	73
6:45 AM	65	61	55	46	33	41	40	48	42	40	48	59	64	62	61	56	42	33	55	59	49	63	63	62	53	67	47	47	62	53	52	53	64	54	64	53	64	72
7:00 AM	65	58	42	30	17	30	49	48	34	32	43	51	49	44	45	40	29	31	52	53	47	62	63	62	52	59	32	36	58	53	52	54	66	55	64	54	65	72
7:15 AM	65	38	31	35	12	24	30	36	24	24	37	50	52	49	46	39	28	31	53	57	48	62	63	63	32	32	19	42	58	53	53	54	66	55	63	54	65	72
7:30 AM	49	20	25	23	13	27	32	31	21	23	37	48	42	35	35	34	27	31	54	59	48	57	50	51	22	27	21	43	54	52	51	53	64	54	62	54	65	72
7:45 AM	25	16	24	13	26	28	24	32	23	22	35	44	40	32	37	37	32	30	55	50	35	40	41	47	19	26	19	44	51	51	50	51	62	53	61	54	64	70
8:00 AM	21	14	16	10	40	55	39	39	30	25	39	49	41	38	44	46	37	32	56	40	28	37	34	39	18	26	19	43	54	52	50	52	63	54	62	54	65	71
8:15 AM	18	14	23	17	40	60	46	44	35	29	39	50	53	49	56	54	42	36	57	44	28	32	29	34	17	26	19	41	53	53	51	54	64	53	62	53	64	72
8:30 AM	24	20	28	22	37	52	41	42	33	26	36	56	63	61	63	60	59	43	56	29	22	30	28	34	20	31	21	42	53	52	50	54	64	54	63	53	65	72
8:45 AM	41	22	29	18	35	46	30	32	23	22	33	55	64	62	64	62	64	48	59	47	34	37	34	42	21	29	21	41	54	53	51	54	64	54	63	53	65	73
9:00 AM	63	43	44	27	22	33	35	45	32	29	41	56	63	59	52	58	62	48	60	60	46	53	35	43	26	32	22	41	56	53	51	54	65	54	62	53	65	72
9:15 AM	67	61	60	44	26	30	39	49	36	38	44	58	64	61	60	60	63	49	59	63	49	59	55	54	28	34	22	42	57	53	51	53	65	54	64	52	66	73
9:30 AM	67	63	62	53	44	53	55	62	58	57	56	62	65	63	64	62	64	50	62	64	50	61	62	59	46	59	35	43	57	53	51	53	64	53	64	52	66	73
9:45 AM	68	64	63	56	52	66	61	66	66	63	60	65	67	65	66	64	66	51	62	65	51	63	64	61	52	67	43	52	62	55	52	54	64	53	65	53	66	73
10:00 AM	68	64	63	55	52	67	60	66	65	64	61	65	68	65	66	65	66	52	63	67	52	64	65	61	53	69	49	54	65	56	53	55	65	54	66	53	66	73

Del Norte | West Valley | Felicita Rd | Via Rancho | Pomerado Rd | Rancho Bernardo Rd | Camino del | Ted Williams Parkway | Mira Mesa Blvd | Miramar Rd | Split I-15 / SR-163

Time																																					
6:15 AM	74	59	65	48	35	40	50	57	57	49	63	68	70	71	70	61	72	69	73	72	67	67	69	65	71	69	70	75	64	69	73	75	73	74	71	75	75	75
6:30 AM	73	56	38	26	22	29	49	59	43	35	61	65	69	70	70	56	72	69	73	71	65	66	60	63	72	69	69	75	60	66	72	74	73	73	66	74	74	74
6:45 AM	73	63	17	44	22	27	48	57	35	33	59	64	69	69	68	46	71	65	73	70	62	63	48	61	71	68	66	75	56	65	68	73	72	73	60	72	73	73
7:00 AM	73	54	20	56	60	54	55	64	35	34	59	63	68	67	63	38	70	64	72	68	61	60	36	61	71	64	58	75	54	65	67	73	71	72	56	71	73	73
7:15 AM	63	24	37	49	58	54	56	67	49	37	62	64	69	69	67	40	70	64	72	65	54	55	25	60	71	59	42	74	55	66	63	72	71	71	54	70	73	73
7:30 AM	43	25	36	50	38	38	48	64	45	36	61	62	68	68	67	40	69	60	72	60	47	28	20	60	71	62	43	74	54	66	60	68	70	71	51	68	71	72
7:45 AM	41	24	27	28	58	64	53	68	54	38	64	65	70	70	69	41	70	62	73	30	24	24	22	60	71	61	44	74	54	65	61	61	69	69	46	64	69	71
8:00 AM	22	21	21	16	51	52	50	63	50	39	62	63	69	69	69	42	72	66	74	35	26	27	22	60	64	48	36	70	54	66	59	63	68	68	46	65	70	72
8:15 AM	15	19	27	21	51	53	48	61	37	33	58	56	67	68	64	37	70	65	73	53	34	28	23	59	42	26	22	40	52	67	62	71	65	62	48	69	71	72
8:30 AM	22	24	24	17	51	53	49	58	33	32	58	60	67	68	57	36	69	58	73	66	55	35	22	59	18	17	17	22	53	66	60	72	62	54	51	72	74	73
8:45 AM	69	46	27	17	50	53	49	59	32	32	57	60	67	66	42	37	69	60	73	65	57	58	27	46	16	18	19	25	54	67	61	72	63	57	44	71	73	73
9:00 AM	72	65	55	31	35	42	51	61	41	36	58	59	67	68	51	39	67	58	72	66	58	60	30	26	15	16	17	28	53	65	61	72	69	66	48	72	73	73
9:15 AM	75	72	72	62	39	38	50	59	58	54	64	63	68	70	70	54	71	65	73	68	61	50	34	18	15	16	16	26	55	65	59	73	71	67	56	72	74	74
9:30 AM	75	73	74	62	60	51	55	61	57	53	65	67	69	70	70	64	72	69	73	71	66	60	40	15	17	19	22	34	55	67	58	73	72	73	62	72	73	74
9:45 AM	75	74	74	65	63	55	63	66	63	60	68	69	71	72	72	66	72	70	73	71	68	65	41	31	20	21	22	47	53	65	58	72	71	71	60	70	70	72
10:00 AM	76	74	75	65	66	59	65	69	64	60	70	69	71	73	73	69	73	72	74	73	71	68	72	63	38	34	34	73	54	65	61	72	70	71	58	69	70	72

Figure 4-3: 15-minute Southbound Speed Contours Real versus Modeled SB-MD-MI (2/9/2015) [Source: TSS]

Time																																				
6:15 AM	64	64	64	65	65	67	55	55	54	55	68	69	67	68	57	68	68	54	69	69	68	58	68	67	69	69	69	55	69	70	69	70	59	57	59	68	68
6:30 AM	63	63	63	64	64	67	55	56	54	55	67	68	67	69	58	67	68	54	69	68	67	58	68	67	68	68	70	55	69	71	69	70	58	57	60	68	68
6:45 AM	61	61	61	63	62	65	54	55	54	55	66	68	68	68	58	68	68	54	69	69	69	60	70	69	70	70	72	56	72	71	72	71	59	57	62	69	69
7:00 AM	62	62	62	63	62	65	54	55	54	55	66	68	67	67	58	67	68	54	68	67	68	59	69	68	70	70	72	56	72	71	72	70	59	57	60	69	69
7:15 AM	63	63	63	64	63	66	54	55	53	56	67	68	66	65	57	67	69	54	69	65	67	57	69	68	70	70	71	56	69	71	71	70	57	55	59	69	69
7:30 AM	64	64	64	64	64	67	56	56	54	56	66	68	66	65	55	65	67	53	69	65	66	56	68	67	69	70	70	55	66	70	70	69	55	47	55	68	69
7:45 AM	64	64	64	65	65	67	56	56	55	56	66	68	68	67	57	67	69	54	70	68	67	57	70	67	70	70	70	56	68	70	71	68	53	38	56	68	69
8:00 AM	64	64	64	64	64	66	55	56	54	56	67	68	67	67	56	66	68	54	69	68	66	57	69	67	70	70	70	56	69	70	72	68	55	39	56	69	69
8:15 AM	64	64	64	64	65	66	55	56	55	56	67	67	68	68	57	66	68	54	69	67	66	56	69	66	69	69	69	55	67	70	71	68	54	36	54	69	69
8:30 AM	64	64	64	64	63	66	54	55	53	55	67	66	68	68	57	65	68	53	68	64	66	56	68	66	67	68	68	55	66	70	70	68	54	37	55	68	68
8:45 AM	62	62	62	63	62	66	53	53	52	53	66	64	65	68	55	64	66	52	66	61	64	54	66	64	66	67	66	53	63	70	69	68	53	37	53	68	68
9:00 AM	62	62	62	63	62	65	53	51	50	53	66	64	65	67	54	63	65	51	65	59	64	53	65	62	65	66	64	52	60	69	66	67	51	34	51	68	68
9:15 AM	65	65	65	65	63	67	53	52	51	53	67	64	65	67	53	63	65	51	65	58	63	53	65	63	66	66	65	51	61	69	67	68	52	46	52	68	68
9:30 AM	64	64	64	64	61	66	52	52	51	52	67	63	65	69	53	63	64	50	65	59	63	52	64	63	65	66	64	51	59	69	66	68	52	52	52	68	68
9:45 AM	65	65	65	64	61	67	52	51	50	52	65	62	64	68	53	63	64	50	65	59	63	52	64	63	65	65	64	51	59	69	66	67	51	53	53	69	68
10:00 AM	65	65	65	65	62	67	53	52	51	52	67	63	65	66	53	62	63	49	63	60	61	51	62	61	64	64	62	50	57	68	65	67	49	52	51	68	68

Time	Merge I-15 / SR-163					Miramar Rd					Mira Mesa Blvd					Ted Williams					Camino Del					Rancho					Pomerado Rd					Via Rancho					Felicita Rd					West Valley					Del Norte		
6:15 AM	72	68	69	61	69	69	74	72	72	74	75	74	75	75	75	76	76	72	75	74	75	72	74	76	76	75	75	76	75	75	75	75	75	74	76	76	76
6:30 AM	60	58	62	55	67	64	73	71	70	72	75	74	74	74	75	76	75	71	75	73	75	69	74	76	76	74	74	76	74	75	75	75	74	72	76	76	76
6:45 AM	68	57	60	52	64	61	72	68	68	72	74	73	73	73	75	76	75	68	74	71	73	65	72	75	75	74	73	76	73	74	74	74	71	68	76	76	76
7:00 AM	65	59	59	53	64	58	69	66	65	71	73	72	73	72	75	75	75	67	74	69	73	65	72	75	75	73	73	75	73	75	74	74	72	69	76	76	76
7:15 AM	70	62	61	50	62	59	70	65	65	70	72	71	72	70	74	75	75	65	73	67	72	61	72	75	75	73	72	75	72	74	74	74	70	70	76	76	75
7:30 AM	65	61	58	50	62	57	69	64	64	69	72	71	72	71	74	75	75	64	72	64	71	60	71	75	74	72	71	75	70	73	73	74	68	68	76	76	75
7:45 AM	66	60	52	48	56	57	65	55	61	67	70	70	72	71	74	74	74	61	72	62	71	57	71	75	75	73	72	75	71	73	74	74	69	69	76	76	75
8:00 AM	68	61	49	48	50	59	57	54	59	66	64	69	70	68	73	72	73	55	70	57	69	56	71	74	74	72	72	75	71	73	73	74	67	71	76	76	76
8:15 AM	70	66	57	51	55	51	33	63	63	69	67	71	71	71	74	72	74	56	71	58	69	57	71	74	74	71	71	75	70	73	73	74	66	71	75	76	75
8:30 AM	69	66	58	49	54	48	40	51	59	66	64	68	69	68	73	72	73	57	69	54	67	54	71	75	75	72	72	75	70	73	74	74	70	71	75	76	75
8:45 AM	72	70	66	54	61	60	66	54	60	68	64	68	70	67	73	72	73	57	68	53	65	52	69	73	73	71	71	75	69	73	73	74	67	68	74	75	75
9:00 AM	70	66	65	53	64	59	71	64	64	70	70	71	72	71	74	74	74	63	72	61	70	59	71	74	74	72	71	75	70	73	73	74	68	69	74	75	75
9:15 AM	72	70	69	53	65	64	71	66	66	70	72	71	72	71	74	75	74	62	72	60	71	60	71	75	74	72	72	75	72	74	74	74	70	70	74	75	75
9:30 AM	73	71	71	55	67	65	73	69	68	71	73	72	73	73	74	75	74	67	72	62	72	60	66	74	74	72	72	75	72	74	74	74	70	69	75	75	75
9:45 AM	73	72	72	58	67	67	74	70	69	72	73	72	73	73	74	75	74	64	72	64	71	60	65	74	74	71	72	75	72	73	73	74	70	67	75	75	75
10:00 AM	73	72	71	60	68	68	74	71	70	72	74	72	73	73	75	75	75	67	73	67	72	60	69	75	74	72	72	75	72	74	74	74	69	68	75	75	75

Figure 4-4: 15-minute Northbound Speed Contours Real versus Modeled SB-MD-MI (2/9/2015) [Source: TSS]

4.5 Calibration Results for Baseline – Cluster NB-HD-HI (6/30/2015)

As explained early in the process the Cluster models were developed starting from the calibrated typical day model. The third cluster takes place between 2:00 pm and 6:00 pm and is a good example where there is a very clear and quick correlation between the generated DSS-congestion event and the Caltrans trigger event. Caltrans event 966317 appeared in the system at 14:30 and involved a 1-lane blockage at milepost 23.85. The 1-lane blockage lasted for 56 minutes and then the event was moved to the shoulder for an addition 20 minutes. Congestion event 853963 was created 4 minutes after the appearance of trigger event at milepost 23.7 and lasted 56 minutes; therefore, meaning the congestion was no longer predicted once the event 966317 was updated to the shoulder. There were two other secondary events during the time period within the network both with no significant impact on the system and at milepost 14.4. Table 4-23 provides the complete summary of the events for this period.

Table 4-23: NB-HD-HI DSS and Caltrans Event Details

Event Type	Direction	ID	StartTime	Duration	EndTime	LinkID location	Blockage	Mile Post Incident
DSS - Congestion	NB	853963	14:34	0:56	15:30	23381	-	23.7
Caltrans Mainline	NB	966317	14:30	0:56	15:26	23381	#4	23.85
Caltrans Mainline	NB	966317	15:26	0:20	15:46	23381	Shoulder	23.85
Caltrans Mainline	NB	966393	15:59	0:18	16:17	23781	Shoulder	14.4
Caltrans Mainline	NB	966399	16:05	0:27	16:32	23781	-	14.4

Associated with congestion event 853963 was the creation of a fairly detailed response plan that was implemented at 2:44 pm and lasted until 3:30 pm. The response plan included the use of one Dynamic Message Sign telling of the location of the incident and a 511 diversion that had traffic exiting I-15 NB at Ted Williams Pkwy EB to Pomerado Road NB, and re-entering I-15 NB at the Pomerado Road I-15 NB on-ramp. The diversion route included 15 signals that had signal timing plan changes and one ramp meter at the end of the diversion, Pomerado Road/W Bernardo Dr I-15 NB on-ramp, which was placed in rate 1 to allow for the highest rate of entry to the freeway. In addition, the ramp meter on the Bernardo Center Drive I-15 NB on-ramp was placed into rate 15 to restrict the flow of traffic into the mainline upstream of the event. Table 4-24 lists the 15 signals and the timing plans that were used for this diversion route.

Table 4-24: NB-HD-HI Signalized Intersection Response Plan Data

Device ID	Location	Plan Implemented
Caltrans.126	Ted Williams Pkwy at I-15 NB	2A
Poway.21	Ted Williams Pkwy at Plmerado Rd	6A
Poway.22	Colony Dr at Pomerado Rd	6A
Poway.24	Pomerado Hospital at Pomerado Rd	6A
Poway.38	Casa Avenida at Pomerado Rd	6A
Poway.54	Monte Vista At Pomerado Rd	6A
SanDiego.1114	Highland Valley Rd at Pomerado Rd	6A
SanDiego.1115	Escala Dr at Pomerado Rd	6A
SanDiego.1116	Mirasol Dr at Pomerado Rd	6A
SanDiego.1118	Oaks North Dr at Pomerado Rd	6A
SanDiego.1119	Greens East Rd at Pomerado Rd	6A
SanDiego.1122	Higa Place at Pomerado Rd	6A
SanDiego.1123	Stone Canyon Rd at Pomerado Rd	6A
SanDiego.1124	Bernardo Heights Pkwy at Pomerado Rd	6A
SanDiego.1241	Paseo Del Verano Norte at Pomerado Rd	6A

4.5.1 Link Count Comparisons

Although the calibration target was for counts greater than 2000, in order to show a goodness of fit of the model the ramp counts were also included as part of the totally summary calibration results as well as the R^2 and slope. Table 4-25 shows the summary of the calibration targets noting that although the sum of all counts meet the targets this model due to its high level of congestion had a few more challenges in meeting the count targets. When reviewing the counts, it is important to keep in mind the balance between the counts and the speeds.

Table 4-25: NB-HD-HI Flow Calibration Summary

Type	Target	Criteria	14:00	15:00	16:00	17:00
Flows <750	< 15% or < 150 veh/hr	>75%	80.8%	68.0%	71.7%	83.3%
750 <Flows < 2000	< 15%	>75%	58.0%	75.7%	65.9%	74.4%
Flows > 2000	< 15%	>85%	91.2%	84.3%	81.9%	88.2%
All Flows	< 15%	>85%	78.2%	84.1%	82.6%	88.8%
Σ Flows	< 5%	<5%	-1.0%	4.3%	0.5%	-3.9%
R2			0.99	0.98	0.97	0.99
Slope			1.00	1.03	0.97	0.91

Tables 4-26 through 4-28 show the hourly details for the flow calibration results. It should be noted that counts that were less than 750 veh/hr were deemed valid if either the <15% difference or absolute difference is <150 (shown with a 1* in the tables) criteria were met.

Table 4-26: NB-HD-HI Flow Calibration Details (part 1)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	2:00-3:00			3:00-4:00			4:00-5:00			5:00-6:00		
El Norte Parkway (1108554)	3064	2927	4.5	2739	2708	1.1	3449	2507	27.3	2654	2467	7.0
El Norte Parkway (1119743)	4137	3908	5.5	4975	4935	0.8	5724	5625	1.7	5493	5363	2.4
56 EB TO 15 NB (1122282)	976	714	26.8	1136	1020	10.2	1214	1186	2.3	1795	1397	22.2
15 NB HOV N/O (1122502)	1275	1246	2.3	1725	1803	4.5	2450	2504	2.2	2076	2329	12.2
Miramar Way (1113862)	118	232	1*	160	247	1*	214	296	1*	96	330	243.5
Carrroll Canyon Road (1108439)	8558	8435	1.4	8407	8976	6.8	7199	8356	16.1	9643	8295	14.0
Carrroll Canyon Road (1113478)	502	700	39.4	761	614	1*	877	866	1.3	944	1008	6.7
Carroll Canyon Road (1108440)	458	277	39.6	508	451	11.1	649	646	0.4	695	778	12.0
S/O Mercy Road (1115838)	7811	7441	4.7	9044	8634	4.5	9058	8275	8.6	9141	8474	7.3
NB I-15 N/O SR-78 (1119736)	4182	4638	10.9	5076	5757	13.4	6122	6678	9.1	5812	6472	11.4
Valley Parkway (1108773)	6360	5463	14.1	7004	6388	8.8	8155	6990	14.3	8224	6540	20.5
Valley Parkway (1108774)	968	860	11.2	936	953	1.8	968	947	2.2	978	816	16.5
Valley Parkway (1108556)	4847	5647	16.5	5061	5268	4.1	5697	5098	10.5	5362	5361	0.0
Auto Park Way/9th Avenue (1100601)	319	673	111.0	352	508	44.4	385	562	45.9	419	555	32.5
Auto Park Way/9th Avenue (1108772)	454	431	5.0	431	505	1*	497	427	14.0	489	405	17.1
Auto Park Way/9th Avenue (1113647)	443	465	5.1	478	655	36.9	592	684	15.6	622	753	21.1
Auto Park Way/9th Avenue (1108771)	5937	5637	5.0	6873	6652	3.2	7904	7303	7.6	7679	6892	10.2
9th Avenue (1108558)	4433	5371	21.2	4575	5204	13.8	5114	4935	3.5	4788	5213	8.9
9th Avenue (1108559)	772	718	6.9	884	882	0.2	988	1022	3.4	978	1002	2.5
Citricado Parkway (1100598)	1056	513	51.5	640	428	33.1	749	445	40.6	651	434	33.3
Citricado Parkway (1113644)	41	92	1*	49	134	1*	48	220	358.8	44	283	542.3
Citricado Parkway (1108769)	6138	5785	5.8	7128	7122	0.1	8272	7454	9.9	7951	7281	8.4
Citricado Parkway (1108770)	355	329	7.4	329	495	50.4	350	363	3.8	302	361	19.6
Citricado Parkway (1108516)	5057	5454	7.9	5379	5292	1.6	5952	5191	12.8	5601	5468	2.4
Citricado Parkway (1108517)	114	104	8.9	99	136	1*	109	152	1*	100	142	41.6
Center City Parkway N/O I-15 (1119438)	1039	907	12.7	1286	1176	8.6	1510	1608	6.5	1513	1683	11.2
Centre City Parkway (1108545)	5218	5565	6.6	5473	5426	0.9	6037	5339	11.6	5725	5620	1.8
Centre City Parkway (1108546)	695	773	11.2	653	788	1*	705	776	10.0	713	794	11.4
Via Rancho Parkway (1108543)	5237	5403	3.2	5494	5324	3.1	6006	5190	13.6	5727	5472	4.4
Via Rancho Parkway (1108544)	1146	1112	2.9	1106	1233	11.5	960	1018	6.0	884	990	12.0
Pomerado Road (1100578)	554	516	6.8	444	508	14.5	483	518	7.2	479	517	7.8
Pomerado Road (1108563)	797	777	2.5	1297	893	31.2	1320	1110	15.9	1043	1138	9.1

Table 4-27: NB-HD-HI Flow Calibration Details (part 2)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	2:00-3:00			3:00-4:00			4:00-5:00			5:00-6:00		
Pomerado Road (1108562)	6307	6424	1.9	7155	7752	8.3	8655	8376	3.2	8871	8291	6.5
Pomerado Road (1108541)	5789	5976	3.2	6042	6054	0.2	6331	5705	9.9	6016	5949	1.1
Pomerado Road (1100524)	143	130	9.4	79	179	1*	98	184	1*	193	207	7.4
Rancho Bernardo Road (1100575)	710	784	10.5	698	834	1*	725	764	5.4	784	806	2.8
Rancho Bernardo Road (1108595)	6586	5778	12.3	6368	7031	10.4	8123	8077	0.6	8391	7849	6.5
Rancho Bernardo Parkway (1108596)	427	483	13.1	467	659	41.2	558	696	1*	523	649	24.1
Rancho Bernardo Road (1108538)	5095	5455	7.1	5466	5337	2.4	5714	4936	13.6	5370	5153	4.0
Rancho Bernardo Road (1108540)	526	506	3.7	645	622	3.5	666	692	3.9	786	763	3.0
Rancho Bernardo Parkway (1108594)	585	549	6.1	710	888	25.1	769	938	22.0	785	887	13.0
Rancho Bernardo Road (1107611)	679	570	1*	419	671	60.1	511	815	59.5	793	1018	28.3
Bernardo Center Drive (1100571)	303	259	14.5	317	285	10.1	342	286	1*	331	295	11.0
Bernardo Center Drive (1108598)	552	507	8.2	708	649	8.4	858	709	1*	692	711	2.7
Bernardo Center Drive (1108597)	5098	4213	17.4	4405	4440	0.8	5602	5580	0.4	6069	5631	7.2
Bernardo Center Drive (1108519)	5546	5765	4.0	6043	6000	0.7	6249	5656	9.5	5969	5998	0.5
Bernardo Center Drive (1108520)	316	448	1*	296	471	59.1	311	586	88.4	372	644	73.2
Bernardo Center Drive (1107608)	664	757	14.0	791	848	7.3	734	1063	44.8	848	1108	30.7
Camino Del Norte (1100568)	594	654	10.2	602	638	5.9	679	636	6.3	652	651	0.2
Camino Del Norte (1108593)	525	332	36.8	684	448	34.6	677	625	7.6	625	675	8.0
Camino Del Norte (1113936)	588	756	28.6	705	778	10.4	714	969	35.7	927	1066	15.0
Camino Del Norte (1108592)	6407	6245	2.5	5020	6000	19.5	6663	7037	5.6	7549	6923	8.3
Camino Del Norte (1108426)	1087	1045	3.9	1268	1292	1.9	1190	1326	11.4	1328	1292	2.7
Camino Del Norte (1108425)	5475	5558	1.5	6156	5848	5.0	6230	5599	10.1	6303	6001	4.8
Carmel Mountain Road (1108590)	5975	6398	7.1	5084	6454	26.9	5899	6941	17.7	6776	6902	1.9
Carmel Moutain Road (1113491)	455	584	1*	516	634	1*	577	695	1*	758	776	2.3
Carmel Moutain Road (1108427)	6077	6222	2.4	7007	6696	4.4	6967	6385	8.3	6999	6744	3.6
Carmel Mountain Road (1108428)	1069	1107	3.6	1026	1149	12.0	1055	1156	9.6	1100	1161	5.5
Ted Williams Parkway (1108589)	217	427	97.0	217	438	101.7	284	382	1*	356	313	12.0
EB SR-56 (1113996)	1407	1073	23.7	1360	1288	5.3	1370	1540	12.4	1229	1318	7.2
Ted Williams Parkway (1113985)	6464	6124	5.3	5566	6657	19.6	6326	6441	1.8	7606	6435	15.4
Ted Williams Parkway (1108429)	5845	5602	4.2	6938	6178	11.0	6850	5825	15.0	6648	6068	8.7
Ted Williams Parkway (1108430)	794	717	9.6	751	842	12.1	863	963	11.6	965	1070	10.9
Rancho Penasquitos (1100560)	159	203	1*	203	244	1*	227	306	1*	258	309	19.7
Poway/Rancho Penasquitos (1113932)	1154	1361	17.9	1339	1356	1.2	1515	1554	2.6	1520	1582	4.1
Rancho Penasquitos (1108489)	6333	6132	3.2	7421	6767	8.8	7355	6481	11.9	7232	6847	5.3
Rancho Penasquitos (1108490)	701	727	3.7	685	750	9.5	654	718	9.8	665	739	11.1
Rancho Penasquitos (1108488)	557	572	2.7	714	694	2.8	668	683	2.3	824	721	12.5
Poway/Rancho Penasquitos (1108585)	6636	6541	1.4	5806	7633	31.5	6264	7023	12.1	8215	7303	11.1
Poway/Rancho Penasquitos (1108586)	359	315	12.2	271	361	1*	254	308	1*	250	357	1*
Mercy Road (1108718)	707	804	13.7	810	804	0.7	810	986	21.8	1003	1042	3.9
Mercy/Scripps Poway (1108717)	7553	7210	4.5	7150	8286	15.9	7146	7640	6.9	9229	7905	14.3
Mercy Road (1108450)	6917	6386	7.7	8029	7144	11.0	7912	6708	15.2	7854	7044	10.3
Mercy Road (1108451)	1061	772	27.3	1130	1142	1.1	1245	1208	3.0	1187	1093	7.9
S/O Mercy Road (1115749)	8522	8189	3.9	7908	9283	17.4	7600	8724	14.8	9835	8941	9.1
Mira Mesa Boulevard (1100553)	647	825	27.4	630	1018	61.7	773	1070	38.4	853	1158	35.7
Mira Mesa Boulevard (1108492)	385	366	5.0	309	340	10.0	379	316	1*	390	331	1*
Mira Mesa Boulevard (1108491)	6774	6600	2.6	7947	7603	4.3	7774	7209	7.3	7503	7322	2.4
Mira Mesa Boulevard (1108500)	334	437	1*	295	432	1*	369	462	1*	458	585	1*
Mira Mesa Boulevard (1108416)	857	803	6.3	538	1025	90.5	699	856	22.5	927	772	16.7
Mira Mesa Boulevard (1108415)	7674	7400	3.6	7633	8020	5.1	6901	7609	10.3	8938	7775	13.0
Mira Mesa Boulevard (1108493)	1035	1024	1.0	856	1150	34.3	744	963	29.4	976	981	0.6
Mira Mesa Boulevard (1100504)	1156	1146	0.9	1101	1317	19.6	1019	1289	26.5	1354	1330	1.8
N/O Carroll Canyon Road (1115739)	9209	8656	6.0	9112	9411	3.3	8137	8925	9.7	10622	9083	14.5
Carroll Canyon Road (1100542)	329	484	47.0	390	452	1*	379	607	60.2	374	743	98.8
Carroll Canyon Road (1108148)	7844	7492	4.5	8647	8598	0.6	8605	7868	8.6	8497	7811	8.1
Carroll Canyon Road (1108518)	736	853	1*	771	931	20.8	834	926	11.1	779	763	2.1
Miramar Road (1108495)	7988	7836	1.9	8628	9053	4.9	8795	8335	5.2	8925	8063	9.7
Miramar Road (1108496)	694	740	6.7	777	792	1.9	756	714	5.5	748	694	7.2
Miramar Road (1100549)	590	484	1*	619	456	26.3	736	479	35.0	504	524	4.0
Miramar Road (1108494)	1248	1120	10.3	1315	1220	7.2	1240	1075	13.3	1323	933	29.4
Miramar Road (1120168)	925	614	33.6	771	1288	67.0	591	1087	83.9	700	1085	54.9
Miramar Road (1120614)	1192	1151	3.4	1263	1073	15.0	1317	1130	14.2	1252	1053	15.9
Miramar Road (1120167)	8174	8228	0.7	9001	8773	2.5	7242	8565	18.3	9782	8516	12.9
S/O Miramar Road (1115820)	7989	8136	1.8	7687	9308	21.1	7950	8511	7.1	9123	8341	8.6
Miramar Way (1108537)	218	105	1*	395	368	6.7	405	500	1*	390	451	1*
Miramar Way (1108536)	9110	9325	2.4	9810	9848	0.4	7238	9342	29.1	9572	9024	5.7

Table 4-28: NB-HD-HI Flow Calibration Details (part 3)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	2:00-3:00			3:00-4:00			4:00-5:00			5:00-6:00		
Miramar Way (1108607)	8549	8715	1.9	8641	9769	13.1	8750	8528	2.5	9702	8648	10.9
Miramar Way (1108608)	338	351	3.7	365	284	1*	381	281	1*	285	182	1*
Miramar Way (1100498)	235	162	1*	256	98	61.7	245	159	1*	161	138	14.3
N/O NB I-15/163 Merge (1115721)	9684	9824	1.4	10842	10173	6.2	7949	9330	17.4	10418	9587	8.0
SB 15 @ CENTRE CITY (1119756)	2892	3097	7.1	2697	2903	7.6	3196	2732	14.5	2319	2678	15.5
NB 15 @ CENTRE CITY (1119749)	4455	4354	2.3	5444	5419	0.5	6181	6177	0.1	6001	5938	1.0
15 NB N/O Poway Rd (1122487)	7035	6866	2.4	6036	7968	32.0	6338	7436	17.3	8388	7768	7.4
15 SB N/O Carrol Cyn (1122479)	8059	7649	5.1	8961	8755	2.3	8803	8053	8.5	8820	7955	9.8
MIRAMAR RD (1122272)	7935	7922	0.2	8239	9116	10.6	8447	8394	0.6	8902	8119	8.8
15 NB S/O Miramar Rd (1122469)	7807	8836	13.2	8927	9173	2.8	9720	8788	9.6	9695	8566	11.6
SB 15 @AMMO RD (1117899)	8333	8967	7.6	7114	9799	37.7	7118	8147	14.5	9638	8669	10.1
Valley Parkway (1108557)	435	415	4.6	416	439	5.6	388	416	7.3	449	413	8.0
Pomerado Road (1108542)	136	129	5.3	152	184	1*	129	139	7.6	121	139	15.0
Poway/Rancho Penasquitos (1108587)	101	39	1*	74	93	1*	94	106	12.3	129	146	13.5
Miramar Road (1108455)	83	67	1*	134	70	1*	77	92	1*	76	135	1*
Valley Parkway (1100604)	843	619	26.6	713	930	30.5	854	849	0.6	845	858	1.5
BERNARDO CTR (1121044)	1844	1427	22.6	2446	2642	8.0	3226	3445	6.8	2973	2832	4.7
Bernardo Ctr (1121037)	6711	5938	11.5	6027	6816	13.1	7765	7939	2.2	8362	7950	4.9
Bernardo Ctr (1121052)	1998	1484	25.7	2482	2685	8.2	3395	3670	8.1	3043	3250	6.8
Bernardo Ctr (1121051)	929	838	9.8	953	1045	9.7	998	1038	4.0	898	1100	22.5
Bernardo Ctr (1121038)	5981	6013	0.5	6529	6278	3.9	6739	5945	11.8	6577	6287	4.4
RCH BERN (1121168)	1954	1717	12.1	2686	2762	2.8	3784	3725	1.6	3306	3518	6.4
RCH BERN (1121165)	847	864	2.0	922	1058	14.7	970	1054	8.7	831	1112	33.8
RCH BERN (1121034)	5808	6292	8.3	6150	6393	4.0	6422	5917	7.9	6146	6194	0.8
Green Vly Ck (1121099)	7050	6766	4.0	7496	8294	10.6	9105	9239	1.5	9282	8944	3.6
Green Vly Ck (1121135)	1704	1162	31.8	2288	2060	9.9	3469	3200	7.8	2961	2905	1.9
Green Vly Ck (1121138)	936	989	5.6	929	988	6.3	1013	907	10.4	915	975	6.6
Green Vly Ck (1121105)	5904	6124	3.7	6215	6240	0.4	6483	5853	9.7	6192	6092	1.6
POMERADO (1121131)	6583	6549	0.5	7094	7982	12.5	8677	8652	0.3	8963	8494	5.2
POMERADO (1121161)	1836	1354	26.2	2665	2327	12.7	3800	3604	5.2	3162	3344	5.8
POMERADO (1121125)	5856	6114	4.4	6199	6235	0.6	6479	5846	9.8	6159	6088	1.1
VIA PKWY (1121142)	936	992	5.9	918	988	7.6	1001	908	9.3	930	974	4.7
VIA PKWY (1121147)	1852	1343	27.5	2663	2310	13.3	3849	3516	8.6	3206	3401	6.1
VIA PKWY (1121118)	7270	7208	0.9	8426	8526	1.2	10001	9439	5.6	9890	9406	4.9
VIA PKWY (1121112)	6356	6482	2.0	6540	6581	0.6	6914	6209	10.2	6568	6453	1.8
VIA PKWY (1121066)	5849	6339	8.4	6081	6217	2.2	6706	6117	8.8	6430	6415	0.2
VIA PKWY (1121154)	1766	1232	30.2	2527	2187	13.4	3120	3271	4.8	2721	3173	16.6
El Norte Parkway (1108555)	600	678	13.1	565	689	1*	551	710	28.9	615	746	1*
El Norte Parkway (1100607)	152	165	8.7	162	194	1*	217	224	3.0	195	218	11.8
Rancho Bernardo Road (1108539)	354	43	1*	350	328	6.3	358	321	10.4	372	367	1.3
15 SB N/O Felicita (1125879)	5227	6097	16.6	5792	6077	4.9	6440	5963	7.4	6206	6215	0.1
HOV South of SR?78 (1123148)	1030	957	7.1	1412	1422	0.7	1803	1899	5.3	1558	1782	14.4
15 NB HOV off SO 78 (1123159)	202	275	1*	280	371	1*	460	551	1*	441	576	1*
15 SB HOV S/O Camino (1122925)	890	717	19.4	980	834	14.9	1025	861	16.0	976	909	6.9
HOV Valley Pkwy (1125321)	660	601	9.0	716	623	13.0	777	540	30.5	722	637	11.8
15 SB HOV SO Rte 78 (1123155)	648	602	7.1	700	623	11.0	766	540	29.5	719	637	11.4
HOV North of SR56 (1123014)	988	775	21.5	1156	974	15.7	1139	1017	10.7	1130	1077	4.7
HOV North of SR56 (1123013)	1629	1185	27.3	2294	2209	3.7	2515	3043	21.0	2595	2778	7.0
15 NB HOV Felicita (1125483)	992	1249	25.9	1700	1818	6.9	2392	2535	6.0	2001	2332	16.6
15 SB HOV NO Felic (1125495)	624	461	26.1	708	502	29.1	756	446	41.0	719	533	25.9
15 SB HOV S/O Felic (1125499)	786	742	5.6	941	967	2.7	1046	896	14.3	952	967	1.6
15 NB HOV S/O Feli (1125491)	1407	1538	9.3	2426	2299	5.2	3426	3277	4.3	2877	3214	11.7
15 SB HOV Center CT (1125503)	936	741	20.8	913	963	5.5	1010	896	11.3	953	966	1.3
15 NB HOV S/O Mercy (1125292)	1877	1725	8.1	2761	2738	0.8	2585	3663	41.7	3245	3613	11.4
15 SB HOV N/O Carrol (1125318)	1142	1150	0.7	1658	1516	8.6	1465	1659	13.2	1512	1546	2.2
15N HOV CARROLL CYN (1115829)	1922	1310	31.8	3270	2677	18.1	2925	3652	24.8	3318	3526	6.3
South of SR?78 (1125265)	3439	3675	6.9	3144	3781	20.3	3824	3595	6.0	3272	3679	12.4
15 N SO Ca del Norte (1123030)	7416	7037	5.1	6278	6895	9.8	7769	7958	2.4	8933	7990	10.6
15 S SO Ca del Norte (1123006)	6779	6913	2.0	7741	7477	3.4	7786	7243	7.0	7958	7677	3.5
15 NB HOV S/O Camino (1122926)	1920	1794	6.5	2651	2951	11.3	3333	3972	19.2	3062	3618	18.2
15 S HV NO Carmel Mt (1122967)	991	783	21.0	1141	975	14.5	1147	1021	11.0	1114	1075	3.5
15 N NO Carmel Mtn (1123031)	6530	6825	4.5	7505	7334	2.3	7558	7084	6.3	7727	7508	2.8
15 N NO Carmel Mtn (1123029)	7164	7092	1.0	5956	7114	19.4	7244	7878	8.7	8300	7890	4.9
15 N HV NO Carmel Mt (1122962)	1940	1809	6.7	2642	2962	12.1	3309	3977	20.2	3066	3621	18.1
North of SR?56 (1123003)	7095	7317	3.1	8070	7842	2.8	7988	7552	5.5	8065	7908	2.0
North of Poway Rd (1125299)	1788	1707	4.5	2433	2694	10.7	2399	3646	52.0	3157	3634	15.1
HOV South of MercyRd (1125288)	1114	1222	9.7	1478	1548	4.7	1368	1668	21.9	1450	1594	9.9
15 SB HOV S/O Mir Rd (1125280)	1182	1407	19.1	1121	1679	49.8	882	1825	106.9	1591	1453	8.7
15 NB HOV S/O Mir Rd (1125284)	2656	1703	35.9	3049	2610	14.4	2697	3466	28.5	2883	3211	11.4
(1125272)	1540	1509	2.0	2496	2619	4.9	1042	3433	229.5	2070	3163	52.8
(1125276)	2330	1871	19.7	2360	2142	9.2	1920	2260	17.7	2510	1850	26.3
I-15 NB Bernardo Center Drive (1120994)	7579	6689	11.7	6870	6771	1.4	8498	8154	4.0	9203	8342	9.4
I-15 NB Ted Williams (1123002)	8198	7886	3.8	7045	8386	19.0	8202	8690	5.9	9507	8826	7.2

4.5.2 Delay, Speed and Bottleneck Comparisons

Below in Figures 4-5 and 4-6 the comparison of the Southbound and Northbound NB-HD-HI (Cluster 3 speed contours and bottlenecks is shown. What can be seen here is that as expected for the PM the northbound is the congested direction while the southbound is mostly uncongested, and for this case due to the severity and duration of the incident the congestion is significantly heavier than the typical day. Unlike the typical day results, which show the 5 minute speeds, these results have been summarize for every 15 minutes. For each figure the real world data is shown on top and the model results are shown below with key interchange names shown for locational perspective. The flow of direction is always left to right.

What these figures do show is that the model is able to do an acceptable job in representing the real world conditions in terms of bottleneck size, and duration as well as the overall reduction in speeds.

Time																																				
2:15 PM	67	63	63	56	59	63	54	60	54	55	53	56	61	59	60	58	59	57	52	55	51	56	60	56	61	66	61	61	64	64	60	61	64	62	64	62	65	72
2:30 PM	63	62	61	60	61	66	59	64	58	60	56	59	63	62	62	60	61	59	55	57	53	58	61	58	62	67	63	61	63	66	61	62	64	63	64	62	64	71
2:45 PM	63	60	57	55	53	58	52	65	51	55	53	56	59	58	56	54	56	56	52	55	50	54	58	54	61	64	62	61	61	65	61	62	63	61	60	60	59	61
3:00 PM	61	58	53	51	50	52	48	58	46	49	44	48	50	48	50	45	50	50	48	51	46	51	52	47	55	56	55	55	56	62	57	57	51	45	42	51	54	60
3:15 PM	62	59	57	57	55	58	55	61	54	58	54	57	59	58	58	52	56	56	54	53	47	47	39	39	55	58	55	47	49	57	56	57	51	42	34	46	51	56
3:30 PM	65	63	62	61	60	65	60	64	59	64	60	63	65	65	63	61	62	62	59	58	49	46	41	39	57	60	58	48	49	58	55	51	37	27	25	30	33	34
3:45 PM	68	65	66	65	64	68	63	66	62	66	63	66	68	68	66	65	65	65	62	65	60	61	61	56	65	66	65	58	60	59	34	29	22	19	22	20	24	22
4:00 PM	69	67	66	67	65	69	64	67	63	67	65	67	69	70	67	66	66	66	65	68	63	66	67	61	68	69	67	64	63	57	28	23	22	20	23	21	23	26
4:15 PM	68	67	66	66	64	68	63	67	62	67	65	68	69	69	68	67	68	67	64	68	64	67	68	59	69	70	69	66	66	68	50	35	21	18	21	18	22	22
4:30 PM	68	65	64	65	63	68	61	66	61	65	64	66	68	67	66	65	66	65	64	67	63	66	67	62	67	69	68	65	66	69	60	37	21	20	23	20	25	25
4:45 PM	69	66	65	64	63	69	64	67	65	67	65	68	69	68	68	66	68	65	63	67	63	66	68	63	67	70	67	66	67	69	61	37	22	20	23	20	25	23
5:00 PM	69	67	67	68	65	69	64	67	67	69	66	68	69	69	68	67	69	67	63	69	64	68	69	62	69	70	69	67	68	71	66	56	33	28	28	26	30	25
5:15 PM	69	69	69	70	67	69	67	68	70	71	67	71	72	71	70	69	71	69	65	69	65	69	70	64	69	70	70	69	68	70	67	67	61	55	48	43	46	40
5:30 PM	69	69	69	70	68	69	67	68	69	71	68	71	72	71	71	70	72	70	65	71	65	70	70	65	71	70	71	69	67	71	69	69	68	66	59	64	63	62
5:45 PM	69	69	67	70	67	68	67	68	69	71	68	71	71	71	70	70	71	70	65	70	66	70	70	65	71	70	71	69	67	71	68	69	66	67	63	67	66	71
6:00 PM	69	70	68	70	67	69	67	68	69	70	67	70	71	70	70	69	71	69	64	70	65	69	70	64	70	70	70	69	67	70	68	69	67	68	64	67	66	73

Time	Del Norte		West Valley		Felicita Rd			Via Rancho		Pomerado Rd			Rancho Bernardo Rd			Camino del				Ted Williams Parkway				Mira Mesa Blvd			Miramar Rd				Split I-15 / SR-163		
2:15 PM	75	74	74	59	64	60	63	67	66	61	69	70	72	74	74	71	74	73	74	73	71	70	75	70	73	70	72	76	67	73	73	75	73	74	66	73	74	74
2:30 PM	75	74	74	54	64	61	63	67	64	60	70	69	73	74	74	71	74	72	74	73	71	69	75	69	73	70	72	76	68	73	72	75	73	73	65	73	74	74
2:45 PM	75	73	74	55	65	61	65	68	62	58	70	69	72	74	74	71	74	72	74	74	71	69	75	68	73	70	72	75	66	74	72	75	73	73	61	73	74	74
3:00 PM	75	74	74	60	64	61	65	67	65	60	70	70	72	73	73	71	74	72	74	73	70	69	75	67	72	68	71	75	63	73	70	74	72	72	54	62	54	55
3:15 PM	76	75	74	63	64	59	62	68	65	60	70	68	72	73	73	68	74	72	74	72	69	68	74	67	72	67	70	75	60	71	68	74	72	71	57	59	53	54
3:30 PM	75	74	74	65	67	64	66	70	68	64	71	70	73	74	74	68	74	72	74	73	68	69	74	68	72	68	71	75	59	72	72	74	72	72	60	24	24	27
3:45 PM	75	74	73	63	64	60	62	68	68	63	71	70	74	74	74	68	75	72	74	73	69	69	75	68	73	68	72	75	59	73	71	74	72	72	62	24	24	26
4:00 PM	75	74	73	63	63	60	60	67	66	62	70	69	72	74	74	68	74	72	74	73	68	68	74	67	72	67	71	75	60	72	71	74	72	73	59	25	24	26
4:15 PM	75	74	74	65	66	62	63	68	67	62	71	70	73	74	74	68	74	72	74	72	66	67	74	67	72	66	70	75	59	72	70	74	72	72	62	25	23	26
4:30 PM	75	74	74	64	66	62	64	69	67	62	71	70	73	74	74	69	75	73	75	74	69	69	75	69	73	68	72	75	62	72	71	74	73	73	63	29	23	26
4:45 PM	75	74	74	63	63	58	61	67	66	62	71	70	73	74	74	67	75	72	74	73	69	68	75	68	73	67	71	75	63	73	70	75	73	73	64	31	23	26
5:00 PM	75	74	74	62	64	59	60	67	64	60	70	69	72	74	74	68	75	72	74	73	68	68	74	68	72	66	71	75	61	73	70	75	73	73	65	28	22	27
5:15 PM	75	74	74	62	64	59	62	67	65	60	70	70	72	74	74	67	75	72	74	73	67	67	74	68	72	66	71	75	62	73	68	75	73	73	66	70	63	68
5:30 PM	75	75	74	61	60	57	59	66	65	61	70	69	72	73	73	67	74	71	74	72	68	67	74	67	72	66	71	75	62	72	68	74	73	73	69	73	68	71
5:45 PM	75	75	73	60	62	58	59	66	65	60	69	69	72	73	74	66	74	71	74	72	67	66	74	65	71	65	69	75	59	72	68	74	73	73	62	74	71	71
6:00 PM	76	75	74	62	65	61	64	69	66	62	71	70	73	74	74	69	75	72	74	73	68	68	75	68	73	68	71	75	61	73	68	75	74	74	68	74	74	73

Figure 4-5: 15-minute Southbound Speed Contours Real versus Modeled NB-HD-HI [Source: TSS]

Time																																					
2:15 PM	68	66	65	66	63	66	63	63	60	63	65	63	64	66	59	58	57	51	53	52	54	55	53	57	53	51	47	49	51	59	56	62	56	54	56	66	65
2:30 PM	67	64	62	65	61	65	62	62	59	63	64	62	64	66	61	59	60	53	53	49	51	53	51	51	54	55	52	50	54	61	59	63	54	53	57	64	59
2:45 PM	65	56	55	60	59	62	61	60	57	61	61	58	57	56	50	51	53	51	49	40	30	31	39	45	45	48	47	47	48	63	53	62	49	50	54	64	61
3:00 PM	47	52	51	57	53	54	54	55	51	54	47	35	29	39	45	48	50	43	35	27	16	21	36	33	36	31	36	45	45	58	50	56	49	47	49	58	54
3:15 PM	33	54	51	56	54	52	51	33	36	40	34	35	33	37	45	45	46	25	18	21	14	17	32	21	43	38	41	45	51	57	54	56	41	37	51	60	54
3:30 PM	33	57	56	59	56	50	39	28	35	50	48	35	27	29	30	32	33	18	11	18	11	14	25	18	35	53	52	45	57	60	61	61	31	30	54	63	59
3:45 PM	35	54	47	53	42	39	33	27	32	48	41	21	16	22	18	28	29	16	11	17	11	14	25	20	28	55	58	45	59	62	62	61	31	32	57	66	63
4:00 PM	36	37	36	43	31	29	20	18	23	23	23	15	12	17	16	27	29	16	11	17	13	18	35	26	36	54	57	45	59	62	61	62	49	41	57	66	64
4:15 PM	28	24	23	25	15	19	14	15	19	18	21	15	11	16	17	29	31	19	14	21	15	20	43	44	43	45	50	45	57	58	59	59	49	39	56	66	63
4:30 PM	17	20	19	19	14	18	12	12	17	18	22	20	14	20	20	32	33	20	16	23	16	21	47	55	49	47	51	45	58	57	57	60	37	33	55	63	64
4:45 PM	13	18	16	16	14	20	17	18	21	23	26	21	17	23	23	33	36	25	19	25	19	24	48	57	49	54	55	45	60	57	57	59	34	32	44	59	64
5:00 PM	14	21	20	24	16	21	17	18	24	28	28	25	25	27	32	34	35	24	18	25	19	25	49	54	49	56	57	45	61	59	59	48	35	30	26	57	64
5:15 PM	14	22	23	25	20	23	21	27	33	39	35	35	30	32	34	36	38	26	20	25	20	25	50	60	56	58	58	45	64	58	55	39	41	36	19	57	63
5:30 PM	16	30	32	34	27	28	29	25	33	39	38	47	32	33	38	38	41	26	22	27	21	26	50	57	49	43	49	45	62	61	60	40	43	41	23	60	64
5:45 PM	18	26	28	33	29	31	33	30	35	43	43	41	34	37	47	44	46	30	25	29	23	29	45	47	44	44	49	45	62	60	61	59	57	56	40	63	64
6:00 PM	17	33	35	39	32	39	34	31	39	54	44	45	48	43	56	55	56	35	28	31	23	28	47	58	52	49	49	45	63	59	60	62	59	61	61	66	66

Time	Merge I-15 / SR-163				Miramar Rd				Mira Mesa Blvd				Ted Williams				Camino Del				Rancho				Pomerado Rd				Via Rancho				Felicita Rd				West Valley				Del Norte		
2:15 PM	73	71	73	62	69	71	74	71	71	69	70	70	71	70	74	69	73	63	73	66	70	65	68	74	75	71	72	74	67	72	72	73	67	60	75	75	75
2:30 PM	71	69	71	55	68	70	73	69	69	60	62	64	68	66	73	61	72	61	72	62	70	63	67	73	74	68	70	73	65	71	72	71	66	57	74	75	74
2:45 PM	71	69	72	54	68	69	72	60	64	49	47	55	63	59	71	38	69	53	67	52	42	24	66	74	74	70	72	74	67	71	72	72	65	58	74	75	74
3:00 PM	47	59	61	54	68	69	71	52	62	41	31	53	61	52	69	32	68	55	62	30	9	15	65	73	71	69	72	73	66	69	71	71	62	58	74	74	74
3:15 PM	53	54	45	52	54	56	47	34	35	26	27	45	58	52	68	26	63	35	12	12	9	15	64	72	72	70	71	72	61	65	69	68	55	51	73	74	74
3:30 PM	66	61	47	51	49	37	16	27	27	25	27	48	54	42	69	20	21	11	9	11	9	17	60	71	73	70	70	72	60	60	66	66	53	42	72	73	72
3:45 PM	68	66	53	47	30	15	15	27	29	25	27	42	51	42	28	12	12	15	12	25	16	20	48	61	70	62	58	38	47	52	63	64	44	43	71	73	72
4:00 PM	66	65	48	36	21	16	16	30	33	25	27	37	41	30	12	16	17	26	17	28	17	22	39	50	70	57	35	28	46	47	62	54	30	39	71	72	72
4:15 PM	69	68	52	38	27	19	18	29	31	25	27	30	30	33	12	16	27	27	18	38	19	22	35	46	55	36	29	27	48	53	55	42	28	30	70	72	72
4:30 PM	66	70	70	53	47	18	16	27	28	24	26	29	21	19	10	14	65	27	16	41	31	24	38	46	25	27	26	26	45	53	58	45	29	29	64	71	71
4:45 PM	70	71	72	56	58	25	15	25	26	22	22	17	15	20	12	18	66	44	38	43	24	24	39	35	22	27	28	27	45	52	63	50	23	41	68	71	71
5:00 PM	69	70	71	55	54	20	14	21	20	19	21	23	21	32	15	19	59	39	24	42	38	26	39	31	22	27	29	26	45	54	60	50	30	31	59	70	71
5:15 PM	70	69	60	38	24	17	16	24	25	23	25	26	23	35	44	21	53	33	20	34	30	25	39	26	22	27	29	26	44	54	66	55	43	39	55	70	70
5:30 PM	70	55	32	24	20	16	15	26	28	23	25	25	23	36	67	33	54	26	16	34	21	23	36	26	22	28	29	26	45	51	65	55	46	41	55	70	71
5:45 PM	71	39	18	19	19	15	15	25	27	23	24	26	24	36	70	40	59	24	19	38	29	26	35	20	22	28	28	24	42	55	67	64	45	40	61	71	72
6:00 PM	71	32	16	17	17	14	15	25	27	23	25	23	22	32	70	47	69	30	22	39	43	33	38	19	20	25	24	23	43	60	68	61	46	44	60	71	72

Figure 4-6: 15-minute Northbound Speed Contours Real versus Modeled NB-HD-HI [Source: TSS]

4.6 Calibration Results for Baseline – Cluster NB-HD-MI (7/7/2015)

As explained early in the process the Cluster models were developed starting from the calibrated typical day model. The forth cluster scenario is a unique scenario compared to the other scenarios evaluated. The major difference is that the trigger Caltrans event did not take place on the mainline but actually took place on the NB I-15 Off-Ramp to SR-78 WB. This ramp is a major 2 lane freeway-to-freeway ramp, which experiences a short closure followed by a one-lane blockage during the afternoon peak. The actual Caltrans event, 839457, was first reported at 5:04 pm and continued up until 6:00pm depending on the different sources that were provided, when investigating the field data that was available for that day it appears that the real impact of the closure was closer to 5:30 and hence for the model the lane blockage has been refined to reflect the field data and is what is shown in Table 4-29, the assumption is that the arrival of emergency vehicles and the repositioning of the vehicles involved as well as the passerby impact were later on. The congestion event is actual event that was created by the system model at 5:19 pm this was not changed as it reflects when the changes associated with the respond. Along the trigger event and the congestion event there were two other events in the network. Table 4-29 shows the adjusted event details as per how they were modeled as described above.

Table 4-29: DSS and Caltrans events for Cluster NB-HD-MI

Event Type	Direction	ID	StartTime	Duration	EndTime	LinkID location	Blockage	Mile Post Incident
DSS - Congestion	NB	639956	17:19	1:00	18:19	2262651	-	31.35
Caltrans Ramp	NB	839457	17:30	0:02	17:32	2279909	#1,2	-
Caltrans Ramp	NB	839457	17:32	0:28	18:00	2279909	#1	-
Caltrans Mainline	NB	839472	17:46	0:07	17:53	27301	Shoulder	17.4
Caltrans Mainline	SB	839468	17:30	0:12	17:42	23769	#3	15.3

Associated with the congestion event, was a response plan that was activated at 5:29:45 pm. This response plan focused around a 511-diversion route that recommended traveler to exit I-15 NB at 9th

avenue, to take Center City Pkwy NB to SR-78 WB from SR-78 WB travelers could either return to I-15 NB or continue on SR-78 WB depending on whether the final destination was west on SR-78 or north on I-15. The diversion route had 11 signals that were changed and the upstream northbound 9th Avenue on-ramp, which was locked at rate 15 that is the most restrictive. Table 4-30 shows the signals used as part of the response plan and the plan that they were set too.

Table 4-30: Signalized Intersection Response Plan Data for Cluster NB-HD-MI

Device ID	Location	Plan Implemented
Caltrans.138	I-15 NB and Ninth Ave	6A
Escondido.100	Center City at Valley Road	5A
Escondido.157	Center City at Second Ave	5A
Escondido.169	Center City at Fifth Ave	5A
Escondido.178	La Teraza and Ninth Ave	8A
Escondido.179	Tulip St and Ninth Ave	8A
Escondido.180	Quince St and Ninth Ave	8A
Escondido.181	Center City at Ninth Ave	5A
Escondido.27	Center City at Grand	5A
Escondido.40	Center City at Mission Ave	5A
Escondido.58	Center City at Washington Ave	5A

4.6.1 Link Count Comparisons

Although the calibration target was for counts greater than 2000, in order to show a goodness of fit of the model the ramp counts were also included as part of the totally summary calibration results as well as the R^2 and slope. Table 4-31 shows the summary of the calibration targets noting that although the sum of all counts meet the targets this model due to its high level of congestion had a few more challenges in meeting the count targets. When reviewing the counts, it is important to keep in mind the balance between the counts and the speeds.

Tables 4-32 through 4-34 show the hourly details for the flow calibration results. It should be noted that counts that were less than 750 veh/hr were deemed valid if either the <15% difference or absolute difference is <150 (shown with a 1* in the tables) criteria were met.

Table 4-31: NB-HD-MI Flow Calibration Summary

Type	Target	Criteria	14:00	15:00	16:00	17:00
Flows <750	< 15% or < 150 veh/hr	>75%	81.3%	84.8%	80.0%	86.1%
750 <Flows < 2000	< 15%	>75%	76.5%	61.1%	52.2%	69.2%
Flows > 2000	< 15%	>85%	96.9%	90.8%	93.8%	98.4%
All Flows	< 15%	>85%	87.1%	85.1%	83.9%	90.4%
Σ Flows	< 5%	<5%	1.3%	2.7%	3.2%	1.8%
R2			0.99	0.99	0.99	0.99
Slope			0.99	1.00	1.02	1.01

Table 4-32: NB-HD-MI Flow Calibration Details (part 1)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	4:00-5:00			5:00-6:00			6:00-7:00			7:00-8:00		
El Norte Parkway (1108554)	2795	2507	10.3	2518	2445	2.9	2125	1930	9.2	1677	1365	18.6
El Norte Parkway (1119743)	5440	6057	11.3	4931	5024	1.9	4101	3973	3.1	2766	2419	12.5
56 EB TO 15 NB (1122282)	1459	1294	11.3	1748	1383	20.9	1222	868	28.9	732	607	17.1
TED WILLIAMS PKWY (1122762)	752	761	1.2	696	758	8.9	614	548	10.8	480	343	28.5
Miramar Way (1113862)	116	289	149.3	94	303	222.6	53	182	1*	32	132	1*
Carrroll Canyon Road (1108439)	10645	10466	1.7	9908	9943	0.4	8463	8397	0.8	5685	5765	1.4
Carrroll Canyon Road (1113478)	726	1136	56.5	905	1103	21.9	636	639	0.4	326	435	33.6
Carroll Canyon Road (1108440)	676	580	14.2	714	642	10.1	520	408	21.6	277	233	16.0
S/O Mercy Road (1115838)	8883	8605	3.1	8858	8940	0.9	7069	7386	4.5	4982	5179	4.0
NB I-15 N/O SR-78 (1119736)	5650	7204	27.5	5325	6181	16.1	4303	4974	15.6	2828	3083	9.0
Valley Parkway (1108773)	7619	7728	1.4	6794	6015	11.5	5838	5555	4.9	3875	4106	6.0
Valley Parkway (1113650)	625	740	1*	616	706	14.5	530	610	1*	258	402	1*
Valley Parkway (1108774)	1076	904	16.0	994	814	18.1	874	734	1*	678	643	5.2
Valley Parkway (1108556)	5167	5386	4.2	5107	5645	10.5	4178	4628	10.8	3111	3071	1.3
Auto Park Way/9th Avenue (1100601)	414	559	1*	402	527	1*	373	514	1*	279	290	4.0
Auto Park Way/9th Avenue (1108772)	512	550	7.5	530	496	6.4	444	337	1*	285	357	1*
Auto Park Way/9th Avenue (1113647)	523	805	53.9	530	876	65.3	439	696	58.5	281	325	1*
Auto Park Way/9th Avenue (1108771)	8046	7932	1.4	7297	6543	10.3	6157	5407	12.2	4101	4127	0.6
9th Avenue (1108558)	4599	5265	14.5	4589	5535	20.6	3658	4500	23.0	2716	3047	12.2
9th Avenue (1108559)	1034	1056	2.1	915	1015	11.0	656	663	1.1	408	415	1.8
Citricado Parkway (1100598)	592	519	12.3	608	515	1*	533	422	1*	399	267	1*
Citricado Parkway (1113644)	170	299	1*	173	331	91.2	130	95	1*	92	100	8.5
Citricado Parkway (1108769)	8352	8282	0.8	7686	7025	8.6	6177	5757	6.8	4138	4136	0.1
Citricado Parkway (1108770)	333	407	1*	344	421	1*	313	268	14.5	258	290	12.3
Citricado Parkway (1108516)	5495	5437	1.1	5360	5741	7.1	4171	4623	10.8	3083	3036	1.5
Citricado Parkway (1108517)	109	147	1*	116	137	1*	83	82	1.7	60	63	5.3
Center City Parkway N/O I-15 (1119438)	1349	1685	24.9	1386	1692	22.0	1000	1377	37.7	604	706	17.0
Centre City Parkway (1108545)	5629	5602	0.5	5481	5880	7.3	4265	4755	11.5	3161	3123	1.2
Centre City Parkway (1108546)	671	809	1*	702	778	10.9	589	564	4.2	405	422	4.2
Via Rancho Parkway (1100581)	736	958	30.2	781	973	24.5	670	820	1*	447	559	1*
Via Rancho Parkway (1108768)	670	656	2.1	623	669	7.3	515	556	8.0	485	525	8.3

Table 4-33: NB-HD-MI Flow Calibration Details (part 2)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	4:00-5:00			5:00-6:00			6:00-7:00			7:00-8:00		
Via Rancho Parkway (1108767)	8537	8783	2.9	7933	7944	0.1	6361	6444	1.3	4091	4243	3.7
Via Rancho Parkway (1113503)	1537	1723	12.1	1729	1778	2.8	1421	1451	2.1	1020	1020	0.0
Via Rancho Parkway (1108543)	5489	5440	0.9	5423	5702	5.1	4158	4520	8.7	3090	2998	3.0
Via Rancho Parkway (1108544)	1109	953	14.1	976	940	3.7	812	826	1.8	789	674	14.6
Pomerado Road (1100578)	514	503	2.1	484	506	4.5	399	454	13.8	296	290	2.1
Pomerado Road (1108563)	834	1034	24.0	907	1040	14.6	496	294	40.7	309	359	1*
Pomerado Road (1108562)	9229	9480	2.7	8648	8595	0.6	7200	7566	5.1	4686	4873	4.0
Pomerado Road (1108541)	5985	5932	0.9	5774	6130	6.2	4459	4929	10.5	3516	3405	3.2
Pomerado Road (1100524)	239	240	0.5	333	330	1.0	291	225	1*	194	232	1*
Rancho Bernardo Road (1100575)	745	789	5.9	740	809	9.3	594	644	8.5	433	434	0.3
Rancho Bernardo Road (1108595)	8818	8861	0.5	8166	8069	1.2	7005	7037	0.5	4511	4679	3.7
Rancho Bernardo Parkway (1108596)	486	607	1*	489	611	1*	322	395	1*	242	301	1*
Rancho Bernardo Road (1108538)	5338	5190	2.8	5177	5442	5.1	4036	4383	8.6	3190	3006	5.8
Rancho Bernardo Road (1108540)	728	712	2.3	769	783	1.8	592	642	8.5	345	343	0.6
Rancho Bernardo Parkway (1108594)	785	843	7.4	870	884	1.7	579	635	9.7	311	303	2.7
Rancho Bernardo Road (1107611)	995	965	3.0	1091	1192	9.3	996	1007	1.1	684	846	23.7
Bernardo Center Drive (1100571)	303	300	0.9	331	292	11.7	227	254	11.9	202	141	1*
Bernardo Center Drive (1108598)	585	622	6.4	600	725	1*	388	436	12.4	260	280	7.8
Bernardo Center Drive (1108597)	6939	6588	5.1	6391	6001	6.1	5743	5453	5.1	3728	3712	0.4
Bernardo Center Drive (1108519)	5920	5962	0.7	5699	6320	10.9	4573	4960	8.5	3440	3387	1.5
Bernardo Center Drive (1108520)	344	583	69.4	398	790	98.6	287	616	114.6	194	377	94.1
Bernardo Center Drive (1107608)	627	1243	98.2	669	1243	85.7	543	1015	87.0	416	617	48.4
Camino Del Norte (1100568)	705	622	11.8	678	672	0.9	566	592	4.6	428	403	5.9
Camino Del Norte (1108593)	584	439	1*	582	494	1*	464	438	5.6	276	401	1*
Camino Del Norte (1113936)	1000	1484	48.4	1196	1656	38.5	1098	1152	4.9	758	867	14.3
Camino Del Norte (1108592)	8083	8228	1.8	7456	7698	3.3	6613	6864	3.8	4432	4601	3.8
Camino Del Norte (1108426)	1202	1308	8.9	1357	1312	3.3	1072	1028	4.1	709	711	0.3
Camino Del Norte (1108425)	6085	5892	3.2	6076	6446	6.1	4736	5014	5.9	3483	3389	2.7
Carmel Mountain Road (1113663)	1111	1253	12.8	1206	1367	13.3	1130	1229	8.8	855	928	8.5
Carmel Mountain Road (1108591)	720	827	14.8	788	943	19.7	704	786	11.7	556	610	9.7
Carmel Mountain Road (1108590)	8516	8878	4.3	8054	8425	4.6	7142	7148	0.1	4668	4818	3.2
Carmel Moutain Road (1113491)	613	667	8.8	755	799	5.8	643	619	3.7	505	512	1.3
Carmel Moutain Road (1108427)	6737	6606	1.9	6819	7084	3.9	5273	5610	6.4	3748	3679	1.9
Carmel Mountain Road (1108428)	1126	1266	12.4	1162	1266	9.0	1069	1075	0.5	815	746	8.4
Ted Williams Parkway (1108589)	288	389	1*	365	466	1*	205	326	1*	126	185	1*
EB SR-56 (1113996)	1470	1651	12.3	1396	1470	5.3	1423	1157	18.7	949	945	0.4
Ted Williams Parkway (1108429)	6597	6079	7.9	6529	6430	1.5	5166	5136	0.6	3673	3481	5.2
Ted Williams Parkway (1108430)	771	865	12.2	864	989	14.5	708	871	23.1	424	695	63.9
Rancho Penasquitos (1100560)	237	338	1*	254	343	1*	210	238	13.5	161	152	5.7
Poway/Rancho Penasquitos (1113932)	1720	1848	7.5	1717	2063	20.1	1440	1817	26.2	980	1210	23.5
Rancho Penasquitos (1108489)	5839	6605	13.1	5828	7093	21.7	4546	5798	27.5	3227	4029	24.9
Rancho Penasquitos (1108490)	743	734	1.2	728	738	1.4	624	660	5.7	405	499	1*
Rancho Penasquitos (1108488)	617	755	1*	697	758	8.7	623	626	0.5	392	419	7.0
Poway/Rancho Penasquitos (1108585)	8669	9202	6.1	8253	8648	4.8	7194	7253	0.8	4899	4891	0.2
Poway/Rancho Penasquitos (1108586)	378	426	12.6	406	414	1.9	334	321	3.8	217	232	7.0
Mercy Road (1108718)	926	1012	9.3	1097	1133	3.3	729	784	7.5	483	525	8.6
Mercy/Scripps Poway (1108717)	9813	10015	2.1	9205	9582	4.1	8091	8231	1.7	5435	5560	2.3
Mercy Road (1108450)	7669	7280	5.1	7618	7668	0.7	6170	6407	3.8	4259	4516	6.0
Mercy Road (1108451)	1224	1198	2.1	1209	1118	7.5	869	839	3.5	596	598	0.3
S/O Mercy Road (1115749)	10741	11396	6.1	10314	10831	5.0	9152	9129	0.2	6167	6262	1.5
Mira Mesa Boulevard (1100553)	751	1136	51.2	819	1314	60.4	721	1098	52.2	530	854	61.1
Mira Mesa Boulevard (1108492)	392	376	4.1	436	441	1.2	269	342	1*	203	249	1*
Mira Mesa Boulevard (1108491)	7585	7460	1.6	7484	7643	2.1	5744	6293	9.6	3963	4348	9.7
Mira Mesa Boulevard (1108500)	453	513	13.2	510	548	7.4	396	475	1*	281	275	2.1
Mira Mesa Boulevard (1108416)	1185	1172	1.1	1244	1208	2.9	1191	1083	9.1	989	931	5.9
Mira Mesa Boulevard (1108415)	9143	9815	7.3	8573	9313	8.6	7725	7708	0.2	5373	5182	3.6
Mira Mesa Boulevard (1108493)	1105	978	11.5	1057	895	15.3	899	845	6.0	766	713	6.9
Mira Mesa Boulevard (1100504)	1614	1323	18.0	1557	1276	18.1	1392	1150	17.4	1010	834	17.5
N/O Carroll Canyon Road (1115739)	11573	11078	4.3	10366	10579	2.1	9369	8829	5.8	6361	6005	5.6
Carroll Canyon Road (1100542)	344	624	81.5	399	641	60.7	325	614	88.9	243	379	1*
Carroll Canyon Road (1108148)	8708	8101	7.0	8554	8234	3.7	6595	6770	2.7	4654	4822	3.6
Carroll Canyon Road (1108518)	877	946	7.9	769	798	3.7	568	680	1*	336	385	14.5
Miramar Road (1108495)	8722	8577	1.7	8451	8480	0.3	6499	7045	8.4	4553	4889	7.4
Miramar Road (1108496)	759	751	1.0	747	685	8.4	591	595	0.7	312	374	19.8

Table 4-34: NB-HD-MI Flow Calibration Details (part 3)

Detector Name (ID)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)	Count	Model	ABS Diff (%)
	4:00-5:00			5:00-6:00			6:00-7:00			7:00-8:00		
Miramar Road (1100549)	482	508	5.4	503	561	11.6	414	432	4.3	316	324	2.5
Miramar Road (1108494)	1156	1157	0.1	1083	1006	7.1	1056	1048	0.7	665	629	5.4
Miramar Road (1120168)	927	1034	11.5	862	1023	18.7	1090	885	18.8	613	789	28.6
Miramar Road (1120614)	1219	1287	5.6	1236	1065	13.8	894	751	16.0	679	806	18.7
Miramar Road (1120167)	10530	10322	2.0	10318	9945	3.6	7794	7832	0.5	5364	5265	1.8
S/O Miramar Road (1115820)	9460	8989	5.0	9119	8762	3.9	7046	7514	6.6	4855	5141	5.9
Miramar Way (1108537)	443	470	6.0	324	429	1*	199	107	1*	121	94	1*
Miramar Way (1108536)	11010	10789	2.0	10916	10548	3.4	8235	8430	2.4	5835	5939	1.8
Miramar Way (1108607)	9858	9598	2.6	9463	9231	2.4	7602	8132	7.0	5208	5567	6.9
Miramar Way (1108608)	446	385	13.6	249	235	5.5	248	145	1*	191	157	1*
Miramar Way (1100498)	287	240	1*	197	131	1*	117	19	1*	97	54	1*
N/O NB I-15/163 Merge (1115721)	11817	10770	8.9	11659	10948	6.1	8584	8669	1.0	6071	6138	1.1
SB 15 @ CENTRE CITY (1119756)	2634	2728	3.6	2414	2663	10.3	2053	2079	1.3	1666	1459	12.4
NB 15 @ CENTRE CITY (1119749)	5913	6636	12.2	5384	5652	5.0	4510	4294	4.8	2997	2588	13.6
15 NB N/O Poway Rd (1122487)	9057	9786	8.1	8668	9260	6.8	7607	7653	0.6	5181	5225	0.9
15 SB N/O Poway Rd (1122494)	5868	6615	12.7	5925	7109	20.0	4959	5777	16.5	3617	4008	10.8
15 SB N/O Carrol Cyn (1122479)	8351	8269	1.0	8346	8421	0.9	6525	6937	6.3	4561	4906	7.6
MIRAMAR RD (1122272)	9205	8674	5.8	8936	8522	4.6	6811	7139	4.8	4742	4911	3.6
15 NB S/O Miramar Rd (1122469)	9750	10482	7.5	9608	10214	6.3	7431	8060	8.5	5354	5621	5.0
SB 15 @AMMO RD (1117899)	9940	9704	2.4	9410	9195	2.3	7654	8220	7.4	5305	5694	7.3
Valley Parkway (1108557)	445	430	3.4	446	431	3.5	306	365	1*	253	254	0.6
Pomerado Road (1108542)	145	153	5.8	150	156	4.3	124	143	1*	109	109	0.2
Poway/Rancho Penasquitos (1108587)	129	175	1*	122	197	1*	108	52	1*	88	92	1*
Miramar Road (1108455)	82	128	1*	87	160	1*	119	77	1*	81	26	1*
Bernardo Ctr (1121037)	9016	8894	1.4	8456	8359	1.1	7449	7393	0.7	4841	5211	7.7
Bernardo Ctr (1121038)	6494	6253	3.7	6352	6614	4.1	5001	5189	3.8	3771	3522	6.6
RCH BERN (1121034)	6085	6142	0.9	5905	6381	8.1	4646	5147	10.8	3598	3547	1.4
Green Vly Ck (1121099)	10823	10084	6.8	10185	9282	8.9	8577	7954	7.3	5633	5298	5.9
Green Vly Ck (1121105)	6115	6096	0.3	5963	6293	5.5	4656	5097	9.5	3626	3525	2.8
POMERADO (1121131)	9376	9736	3.8	8868	8894	0.3	7409	7776	4.9	4800	5102	6.3
POMERADO (1121125)	6132	6080	0.8	5921	6295	6.3	4620	5075	9.8	3618	3522	2.7
VIA PKWY (1121118)	10042	10510	4.7	9582	9704	1.3	7708	7881	2.2	5045	5246	4.0
VIA PKWY (1121112)	6580	6407	2.6	6353	6634	4.4	4939	5368	8.7	3859	3683	4.6
VIA PKWY (1121066)	6241	6401	2.6	6173	6667	8.0	4817	5323	10.5	3542	3547	0.2
El Norte Parkway (1108555)	612	695	13.6	620	762	1*	507	699	37.9	432	429	0.7
El Norte Parkway (1100607)	202	220	9.0	199	220	10.5	163	161	1.1	130	99	1*
Rancho Bernardo Road (1108539)	345	339	1.7	332	396	1*	293	143	1*	209	168	1*
Auto Park Way/9th Av (1122779)	639	407	36.4	586	472	1*	427	293	1*	309	195	1*
15 SB HOV NO Felic (1125495)	628	351	44.0	574	396	31.0	419	242	42.3	303	146	51.9
15 NB HOV Citracado (1125486)	946	1029	8.7	769	1027	33.6	491	722	47.0	202	300	1*
15 SB HOV S/O Felic (1125499)	866	776	10.4	773	805	4.2	615	486	1*	429	373	13.1
15 SB HOV Center CT (1125503)	861	769	10.7	750	806	7.4	570	494	13.4	404	372	7.9
15 SB HOV N/O Carrol (1125318)	1520	1402	7.7	1508	1361	9.7	1045	1081	3.5	470	736	56.6
South of SR?78 (1125265)	3311	3692	11.5	3111	3699	18.9	2551	2848	11.6	2119	2090	1.4
15 N SO Ca del Norte (1123030)	9254	9710	4.9	8912	9360	5.0	7933	7985	0.7	5295	5454	3.0
15 N NO Carmel Mtn (1123031)	7370	7253	1.6	7573	7876	4.0	5923	6208	4.8	4262	4182	1.9
15 N NO Carmel Mtn (1123029)	9177	9697	5.7	8665	9378	8.2	7708	7941	3.0	5154	5433	5.4
North of SR?56 (1123003)	7981	7860	1.5	8099	8361	3.2	6460	6700	3.7	4669	4440	4.9
HOV South of MercyRd (1125288)	1056	1299	23.0	1038	1262	21.6	806	970	20.3	449	614	36.7
15 SB HOV S/O Mir Rd (1125280)	1121	1305	16.4	1078	1197	11.0	822	982	19.5	457	629	37.7
(1125276)	2384	1644	31.0	2176	1520	30.1	1723	1292	25.0	1143	864	24.4
I-15 NB Ted Williams (1123002)	11301	10884	3.7	10886	10377	4.7	9720	8778	9.7	6505	6028	7.3

4.6.2 Delay, Speed and Bottleneck Comparisons

Below in Figures 4-7 and 4-8 the comparison of the Southbound and Northbound NB-HD-MI (Cluster 4 speed contours and bottlenecks is shown. What can be seen here is that as expected for the PM the northbound is the congested direction while the southbound is mostly uncongested, and for this case due to the severity and duration of the incident the congestion is significantly heavier than the typical day. Unlike the typical day results, which show the 5 minute speeds, these results have been summarize for every 15 minutes. For each figure the real world data is shown on top and the model results are shown below with key interchange names shown for locational perspective. The flow of direction is always left to right.

What these figures do show is that the model is able to do an acceptable job in representing the real world conditions in terms of bottleneck size, and duration as well as the overall reduction in speeds.

Unlike the typical day or cluster 3 for the PM this cluster shows a less congested situations as the event is on a ramp rather than on the mainline of the freeway.

Time	Del Norte			West Valley			Felicita Rd			Via Rancho			Pomerado Rd			Rancho Bernardo Rd			Camino del			Ted Williams Parkway			Mira Mesa Blvd			Miramar Rd			Split I-15 / SR-163		
4:15 PM	69	67	66	67	65	65	65	65	63	68	65	68	69	68	67	67	69	68	65	68	66	67	68	66	69	69	66	66	65	68	66	67	68	67	65	66	66	71
4:30 PM	68	67	65	67	64	64	64	64	63	68	65	68	69	68	68	67	68	67	66	68	65	67	68	67	68	69	65	66	65	68	66	67	68	67	65	66	65	71
4:45 PM	69	68	66	68	65	65	64	64	63	68	65	68	69	68	69	67	69	67	67	68	65	67	68	67	69	69	66	67	65	68	66	67	68	66	65	66	66	72
5:00 PM	69	69	64	68	65	65	65	65	64	69	66	69	70	69	70	68	70	68	65	69	66	68	69	66	68	69	66	66	65	68	65	67	68	67	65	66	65	73
5:15 PM	69	69	65	68	65	65	65	65	64	68	66	69	69	68	67	69	67	65	69	65	67	69	67	69	69	69	67	68	66	69	66	67	68	67	65	67	66	73
5:30 PM	69	69	66	70	68	68	67	67	66	70	68	70	71	71	70	69	71	69	66	69	66	69	69	67	69	69	67	67	65	68	65	67	68	67	65	66	65	72
5:45 PM	69	67	66	69	67	67	66	66	66	70	68	71	71	71	71	70	71	69	67	70	67	69	70	68	71	70	68	70	66	70	67	69	69	68	65	67	66	73
6:00 PM	69	69	66	66	66	66	67	67	65	69	65	70	70	70	70	69	71	69	68	70	66	70	70	68	71	70	68	69	67	70	68	69	69	69	66	68	67	74
6:15 PM	69	69	67	69	67	67	67	67	66	70	67	70	71	71	70	69	71	70	68	70	66	69	70	69	71	70	67	69	66	70	68	69	70	69	67	68	68	75
6:30 PM	68	66	64	69	66	66	68	68	67	70	68	70	71	72	71	71	73	71	71	71	67	70	71	69	72	70	68	70	67	70	68	69	69	68	67	68	67	74
6:45 PM	69	65	63	68	66	66	67	67	66	69	67	69	70	69	70	69	70	69	66	69	66	69	69	68	70	70	67	69	67	69	68	69	69	68	68	68	67	74
7:00 PM	69	67	64	71	68	68	69	69	68	70	68	71	71	71	71	70	71	69	67	70	66	70	70	68	70	71	67	69	68	69	68	68	69	68	68	68	68	74
7:15 PM	69	69	66	72	69	69	69	69	69	72	69	71	72	72	71	72	72	71	65	72	68	71	71	70	71	72	68	70	68	71	69	70	71	70	69	69	69	75
7:30 PM	69	69	68	71	68	68	68	68	69	72	69	72	72	72	72	72	73	71	65	72	68	71	72	71	72	72	69	71	69	72	70	71	71	70	70	66	69	76
7:45 PM	69	68	67	69	67	67	67	67	69	71	69	70	71	71	71	71	71	70	66	71	67	69	70	69	72	72	69	70	69	71	70	70	70	69	69	64	69	75
8:00 PM	69	68	66	68	66	66	66	66	68	70	67	70	71	70	71	70	70	69	66	70	66	69	70	67	71	72	69	69	68	71	70	69	69	69	69	68	69	75

Figure 4-7: 15-minute Southbound Speed Contours Real versus Modeled NB-HD-MI [Source: TSS]

Time	Merge I-15 / SR-163			Miramar Rd			Mira Mesa Blvd			Ted Williams			Camino Del			Rancho			Pomerado Rd			Via Rancho			Felicita Rd			West Valley			Del Norte		
4:15 PM	64	64	64	64	63	65	64	62	57	58	47	60	65	64	61	63	66	63	64	62	47	55	58	63	64	64	64	59	66	66	65	65	62	63	63	66	66
4:30 PM	63	63	63	63	63	64	64	62	57	60	54	59	63	64	61	61	65	63	64	63	45	48	49	62	64	64	63	56	63	63	64	64	60	63	63	66	65
4:45 PM	62	62	62	61	63	64	65	62	58	63	62	63	66	65	62	63	67	65	64	63	54	55	58	63	64	64	62	57	66	66	64	64	61	62	63	66	66
5:00 PM	62	62	62	62	64	64	64	48	47	62	62	64	67	64	59	63	67	66	66	63	62	63	64	65	67	66	64	60	68	68	65	65	63	61	61	66	66
5:15 PM	63	63	63	64	64	64	65	51	46	60	62	63	67	65	59	63	67	66	66	64	63	64	64	65	65	65	65	61	67	67	66	66	63	59	62	66	66
5:30 PM	62	62	62	63	63	57	51	43	43	60	60	64	67	65	62	64	68	67	67	65	63	64	62	66	66	66	64	62	67	67	67	67	62	60	64	66	66
5:45 PM	61	61	61	62	58	49	45	31	34	41	49	63	67	64	63	65	69	68	68	65	65	66	66	68	68	67	66	62	69	69	67	67	62	55	60	67	67
6:00 PM	63	63	63	62	58	41	34	28	31	45	48	61	66	63	61	63	67	66	66	64	64	65	66	67	68	68	66	63	68	68	67	67	46	45	61	67	68
6:15 PM	65	65	65	65	65	56	50	38	41	55	53	57	66	64	62	63	67	66	67	64	65	65	66	67	68	68	67	63	66	66	67	67	37	40	60	67	67
6:30 PM	66	66	66	66	67	66	66	62	59	65	62	62	67	65	62	65	69	68	68	66	65	66	67	67	68	67	67	61	68	68	67	67	58	50	63	67	67
6:45 PM	66	66	66	66	67	68	69	67	65	68	65	67	69	67	65	66	70	69	70	67	67	68	70	69	70	70	70	64	70	70	70	70	67	66	68	68	68
7:00 PM	67	67	67	67	68	69	69	68	67	69	66	68	70	69	67	67	72	71	71	68	68	69	72	70	71	71	71	66	71	71	70	70	70	68	69	68	68
7:15 PM	68	68	68	68	68	69	69	69	68	70	68	69	70	69	67	66	71	70	71	68	68	70	72	71	72	71	71	65	71	71	71	71	73	70	69	69	69
7:30 PM	68	68	68	68	69	69	69	69	70	68	70	70	70	68	66	70	68	70	67	67	70	70	69	70	71	71	65	71	71	70	70	72	69	69	69	69	69
7:45 PM	68	68	68	69	68	70	69	68	68	69	68	69	70	70	67	66	71	68	69	66	68	69	70	68	70	70	70	65	69	69	70	70	72	69	68	68	69
8:00 PM	68	68	68	69	67	69	69	68	67	68	68	69	70	70	67	66	70	67	69	66	67	69	70	68	70	71	70	67	69	69	70	70	68	69	67	69	69

Time	Merge I-15 / SR-163			Miramar Rd			Mira Mesa Blvd			Ted Williams			Camino Del			Rancho			Pomerado Rd			Via Rancho			Felicita Rd			West Valley			Del Norte		
4:15 PM	72	69	35	27	26	27	24	39	57	64	39	50	67	58	72	58	72	61	68	41	42	32	61	39	42	52	60	55	69	62	68	67	62	45	72	73	73
4:30 PM	72	72	62	48	42	38	26	39	57	62	36	49	67	59	72	59	71	58	67	45	69	55	69	40	33	47	54	50	67	59	69	67	46	45	72	73	72
4:45 PM	73	72	68	53	58	48	44	42	59	61	33	47	67	53	72	60	72	58	68	47	70	58	69	63	50	47	54	52	67	57	70	69	49	44	71	73	72
5:00 PM	73	72	69	54	62	51	55	50	61	64	41	52	68	54	72	64	72	59	68	44	69	57	69	66	62	51	60	56	69	65	71	69	59	46	70	72	72
5:15 PM	74	72	67	51	61	50	54	53	62	66	59	57	70	64	73	67	72	58	71	49	71	62	70	65	67	59	63	58	69	64	71	71	69	52	72	73	73
5:30 PM	73	71	61	50	58	49	51	51	61	63	55	51	69	61	73	68	73	57	70	47	68	59	70	65	67	61	64	58	70	64	71	72	69	54	72	74	73
5:45 PM	74	72	66	51	57	50	48	49	61	62	53	46	69	56	73	67	73	59	70	47	69	61	70	66	68	63	66	58	67	65	72	72	71	48	73	74	73
6:00 PM	74	73	70	51	65	53	56	53	62	63	51	49	70	59	73	68	73	59	70	46	70	63	71	67	70	65	68	64	69	69	72	73	49	41	74	74	75
6:15 PM	72	73	70	53	67	60	62	55	61	61	63	54	70	66	73	68	74	61	72	53	71	62	72	71	70	68	72	68	72	72	73	74	37	44	68	72	74
6:30 PM	72	73	71	54	67	63	64	55	61	63	59	51	69	71	72	69	72	64	71	52	71	65	71	71	67	64	72	65	72	72	73	73	73	51	69	72	74
6:45 PM	73	73	72	58	68	66	69	62	67	68	69	64	71	72	73	72	73	66	72	59	71	67	71	72	68	65	71	66	72	71	72	72	72	54	74	75	75
7:00 PM	74	74	73	62	69	66	72	70	71	73	74	70	74	75	75	75	75	68	74	67	74	70	73	73	72	70	72	70	73	73	74	73	73	62	75	75	75
7:15 PM	75	75	74	67	71	67	72	69	70	73	73	71	74	75	75	75	75	69	75	68	74	70	74	74	73	72	73	72	74	74	74	74	73	67	75	76	75
7:30 PM	75	76	74	68	72	69	73	72	72	74	74	72	74	75	75	75	75	70	75	71	74	71	74	74	74	73	74	73	75	74	74	74	74	67	75	76	76
7:45 PM	76	76	75	70	73	71	74	73	74	75	74	72	75	75	76	76	76	71	76	73	75	73	75	75	75	74	75	75	75	75	75	75	75	70	76	76	76
8:00 PM	76	76	75	69	74	71	74	74	74	75	75	73	75	76	76	76	76	73	76	73	76	74	75	75	75	74	75	75	75	75	76	76	75	71	76	77	76

Figure 4-8: 15-minute Northbound Speed Contours Real versus Modeled NB-HD-MI [Source: TSS]

4.7 Hypothetical Case

The typical day scenario will be used with an artificial major incident in order to be able to place the congestion in a location that will be able to be used with a controlled alternate route that will include 8 Multi-Modal Intelligent Traffic Signal System (MMITSS) signals. Figure 4.9 shows the rough location of the hypothetical incident in red and the location of the 8 MMITSS signals in green. The only calibration for this case study is the Typical Day results for the PM time period as described early in this document. The idea is to have a severe incident lasting approximately 2 hours and starting with 3 lanes closed during the start of the peak (around 4:30) and ending with the shoulder freeway closed. The Pomerado Road diversion, which under the typical day is not overly congested, will be use to divert traffic around the event and due to the overall congestion created on the mainline will become congested warranting the use of the MMITSS application.

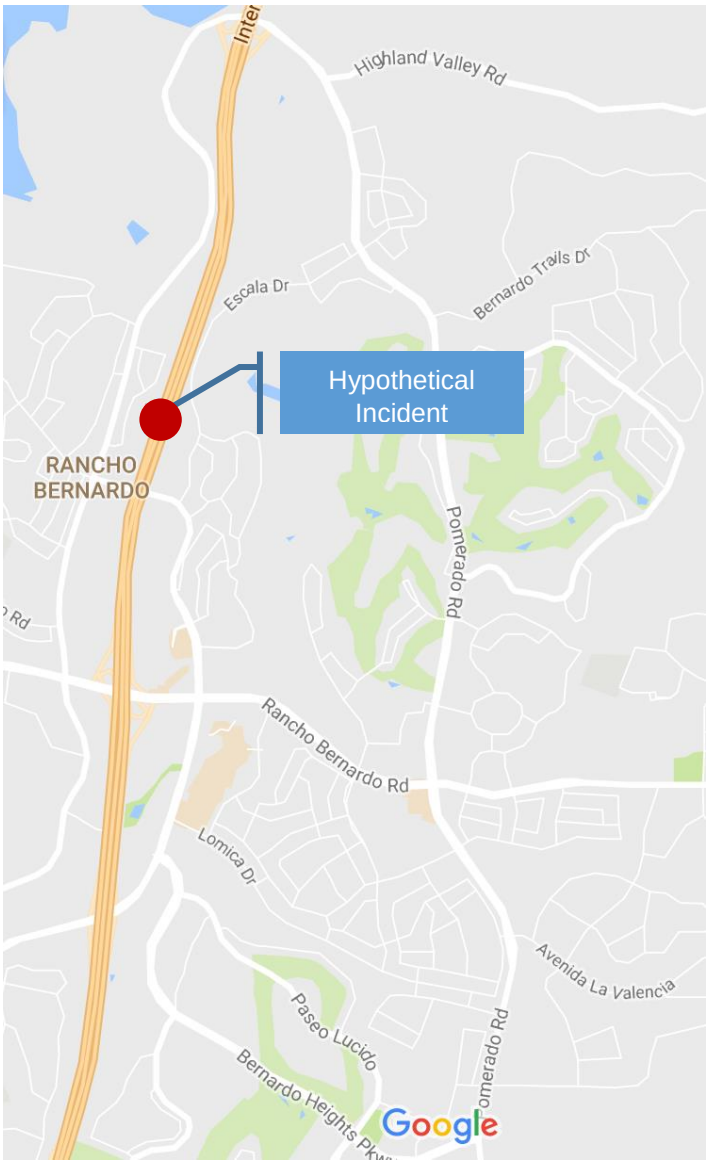

Figure 4-9: Hypothetical Case Incident Location [Source: TSS]

4.8 Summary

This report presents the methodology used to calibrate the Aimsun microsimulation model for the baseline scenarios that were identified to through the post ICM evaluation cluster analysis. The calibration methodology involved starting with the already calibrated Aimsun ICM Online model for the I-15 corridor and taking the update to the typical day. This was done using standard modeling calibration techniques. As shown the typical model was well calibrated and deemed useable as the base for the four analysis clusters.

It is worth mentioning that the calibration of such large-scale simulation models is a challenging task. Especially for the NB-HD-HI event where the severity of the congestion caused by the incident during the PM peak period causes a significant change when compared against the typical day. However, through the efforts of the calibration the model was sufficient set to be able to model this condition and also in therefore usable for testing various scenarios over the 3 phases of the project.

Completing the calibration of the baseline scenarios is a significant milestone for this project. The next steps involve using these models to complete the three phases of the analysis plan and provide potential impacts and benefits from the various combinations of ATDM strategies and DMA applications.

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