

District 11 Transportation System Management and Operations (TSMO) Sub Regional Operations Forum

April 12-14, 2016

Interstate 15 Integrated Corridor Management Project

ICM Project Overview

Regional Vision Context

ICM Project Overview

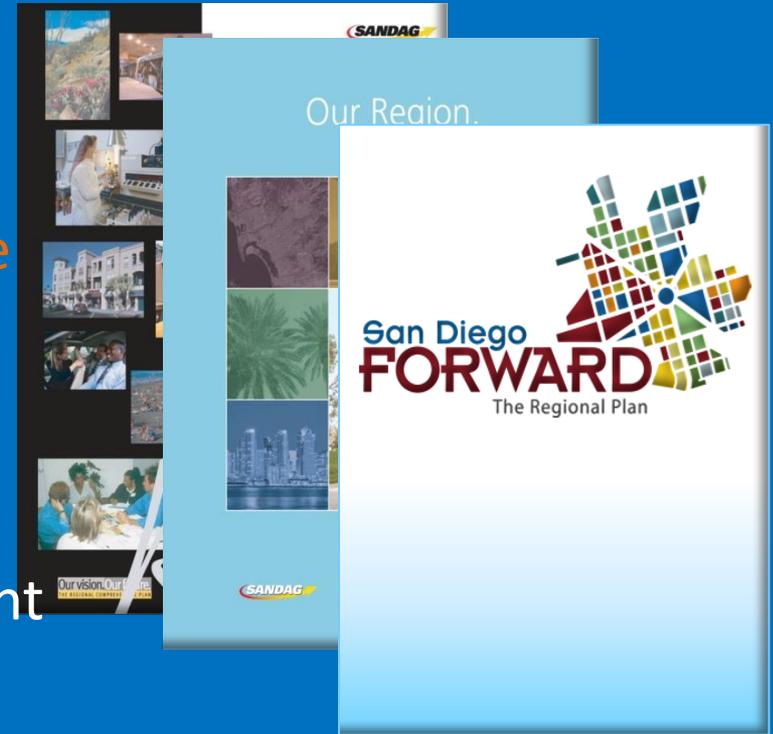
- *Why ICM*
- *ICM System Overview*
- *Vision to Development*

What is Happening Now

Next Steps

Regional Vision

- Multi Modal Integration, Performance Based Management
- Traveler Information
- Arterial, Freeway, Transit Management
- Vehicle Automation (New)
- Universal Transportation Account (New)
- ITS for Transit and Transit Infrastructure Electrification (New)
- Active Traffic and Demand Management (New under TDM)



Early Efforts: Strategic Assessment

	Level 1 Silo	Level 2 Centralized	Level 3 Integrated	Level 4 Multimodal Integrated	Level 5 Multimodal Optimized
Planning	Functional Area Planning (single mode)	Project-based Planning (single mode)	Integrated agency wide planning (single mode)	Integrated corridor-based multimodal planning	Integrated regional multimodal planning
Data Collection (vehicle tracking)	Limited or Manual Input	Near real-time for major routes	Real-time for major routes using multiple inputs	System-wide Real-time data collection (single mode)	System-wide Real-time data collection across all modes
Data Integration	Limited	Networked	Common user interface	2-way system integration	Extended integration
Network Operations	Ad-Hoc, Single Mode	Centralized, Single Mode	Automated, Single Mode	Automated, Multimodal	Multimodal Real-time Optimized
Incident Management	Manual detection, response and recovery	Manual detection, coordinated response, manual recovery	Automatic detection, coordinated response and manual recovery	Automated pre-planned multimodal recovery plans	Dynamic multimodal recovery plans based on real-time data
Analytics	Ad-hoc analysis	Periodic, Systematic analysis	High-level analysis in near real-time	Detailed analysis in real-time	Multi-modal analysis in real-time
Demand Management	Individual static measures	Individual measures, with long term variability	Coordinated measures, with short term variability	Dynamic pricing	Multimodal dynamic pricing
Payment Methods	Manual Cash Collection	Automatic Cash Machines	Electronic Payments	Multimodal integrated fare card	Multimodal, multi-channel (fare cards, cell phones, etc)
User Information Services	Static Information	Real-time information by mode	Multimodal Real-time trip planning.	Location-based, on-journey multimodal information	Location-based, multimodal proactive re-routing
Performance Measurement	Minimal	Defined metrics by mode	Limited multimodal metrics	System-wide multimodal system-wide metrics	Continuous system-wide performance measurement

Why Performance Based - Corridor Management

Five Primary Goals:

1. The corridor's multi-modal and smart-growth approach shall **improve accessibility** to travel options and attain an enhanced level of mobility for corridor travelers.
2. The corridor's safety record shall be enhanced through an integrated multimodal approach.
3. The corridor's **travelers** shall have the informational tools to make smart travel choices within the corridor.
4. The corridor's **institutional partners** shall employ an integrated approach through a corridor-wide perspective to resolve problems.
5. The corridor corridors networks shall be **managed holistically** under both normal operating and incident/event conditions in a collaborative and coordinated way

Why I-15 Corridor: Working Together as a Single System

- 1 Main Lanes
- 2 Express Lanes
- 3 DAR
- 4 Transit
- 5 Rapid Transit Station
- 6 Arterial Network



Overall ICM Strategies

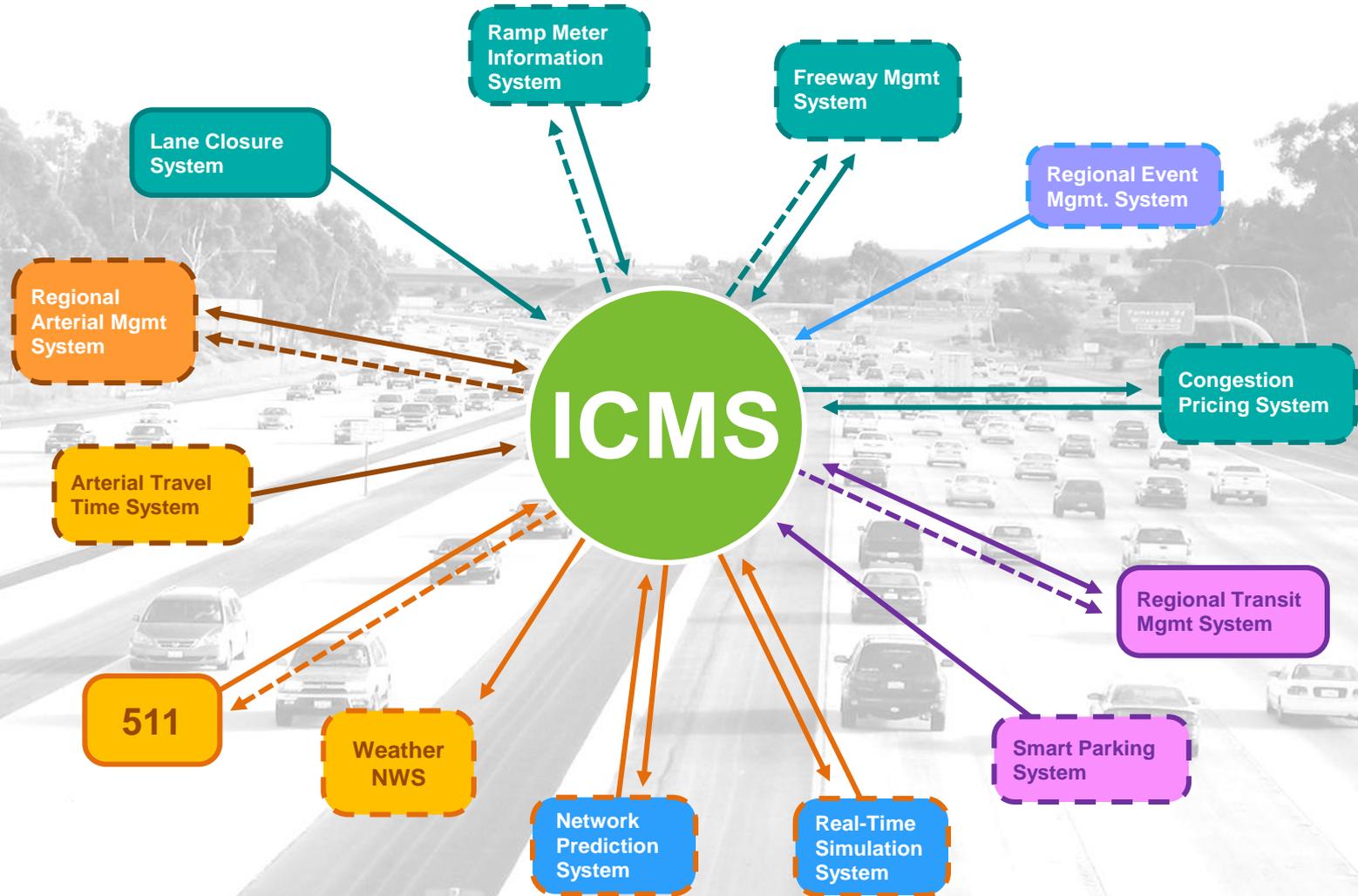
- Implement Active Traffic Management (ATM):
- First in the nation real-time multimodal response and control (DSS System)
 - Proactively manage multiple modes through and along the corridor
 - En-route traveler information (CMS Signs, 511 San Diego mobile app)
 - Pre-trip traveler information (511 San Diego mobile app, 511 phone system)
 - Signal coordination on local roadways with freeway ramp metering
 - Transit rerouting
- Dynamic rerouting – May 2016
- Corridor ramp metering – Fall 2016



Project Opportunities: Operational



Project Opportunities: Technical



Why ICM: Change How We Manage and Operate Transportation Assets

Institutional
Integration

Operational
Integration

Technical
Integration

- **Commitment** - collaboration between various agencies, modes, and jurisdictions that transcends institutional boundaries
- **All inclusive customer focus** - Joint operational objectives and strategies to manage and balance the total capacity and demand of the corridor
- **Sharing and distribution** - of information and system operations control functions to support the analysis and immediate response

ICMS : Solution Proposed

Data Integration /
Fusion Engine

Business Rules
Engine

Corridor
Visualization

Real-Time Network
Prediction

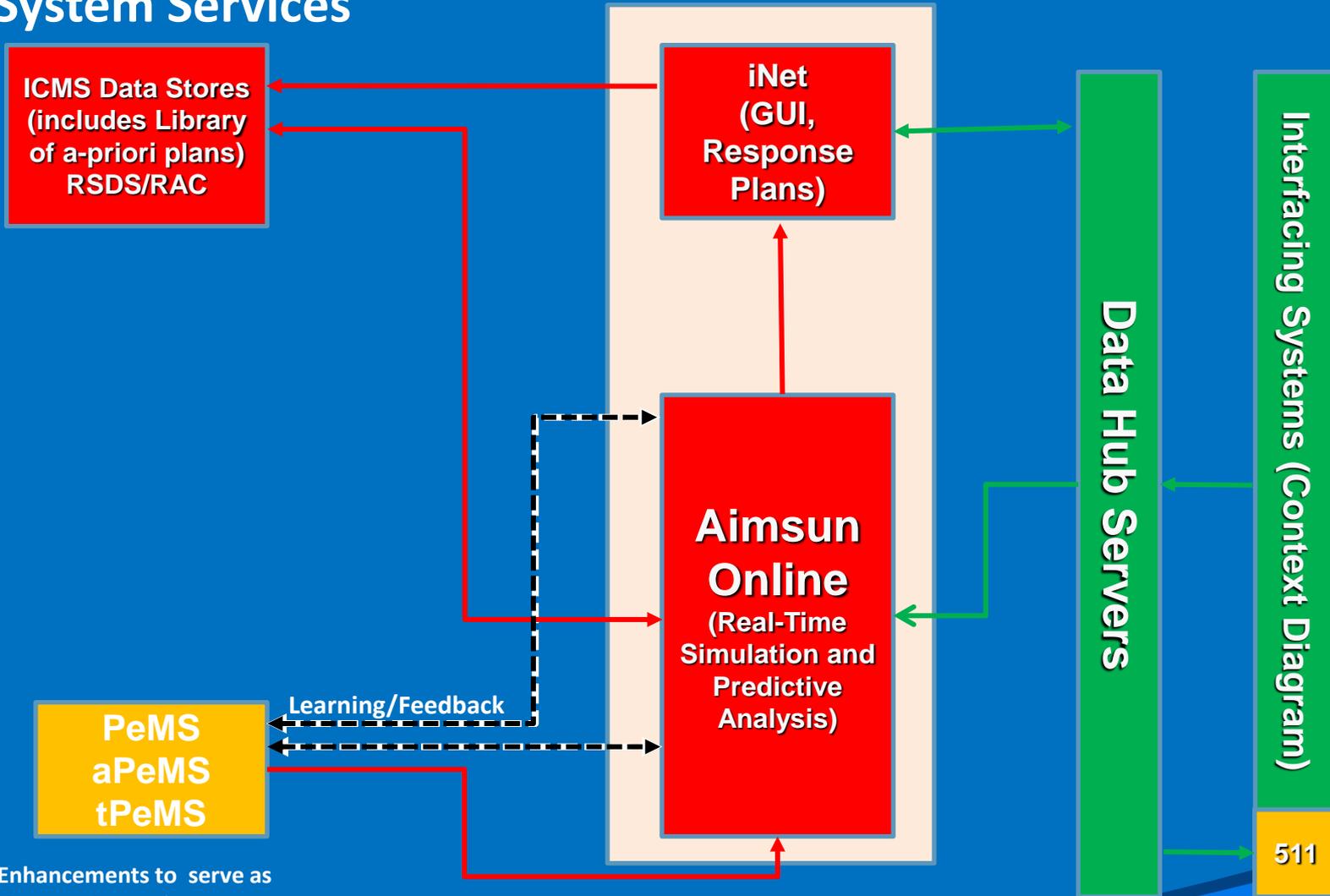
Response Plan
Evaluation Engine

Automation
Workflow Engine

Performance
Data Warehouse

ICM Core Elements

System Services



Enhancements to serve as the corridor performance management element of DSS

Vision to Development

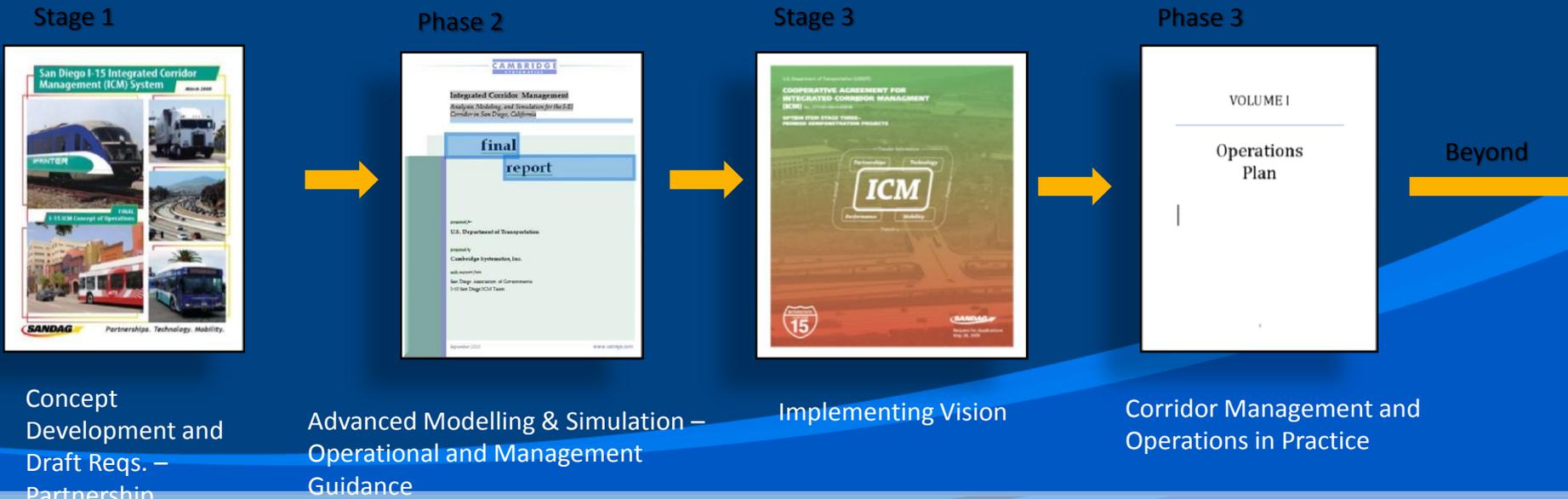
MOUs

Management Framework

Technical Memorandum



Common Vision – Management/Operations – Day to Day Operations



Concept Development and Draft Reqs. – Partnership Commitment

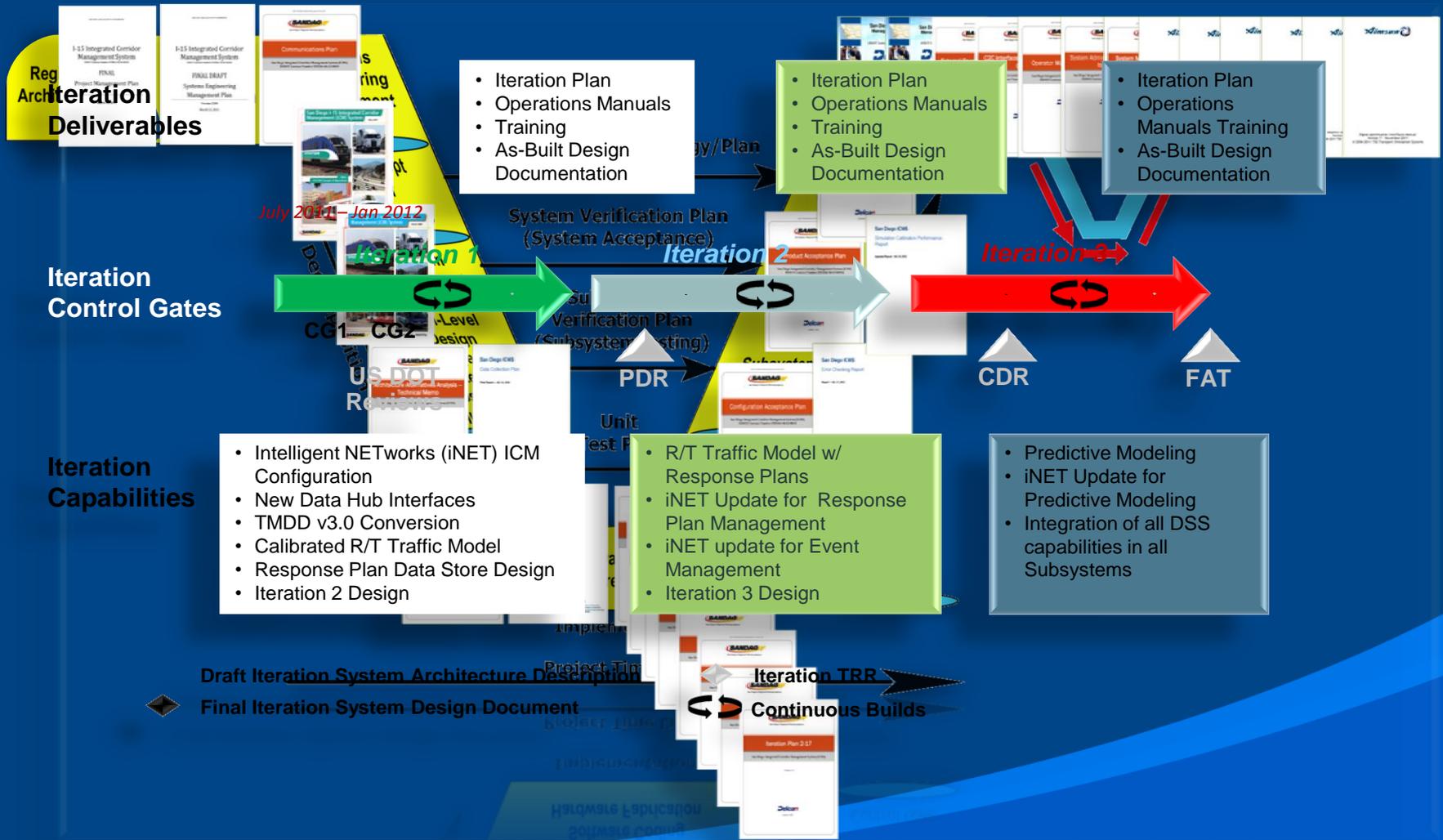
Advanced Modelling & Simulation – Operational and Management Guidance

Implementing Vision

Corridor Management and Operations in Practice



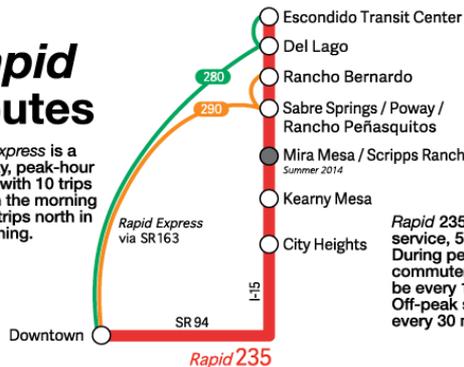
Vision to Development: System Eng. Process



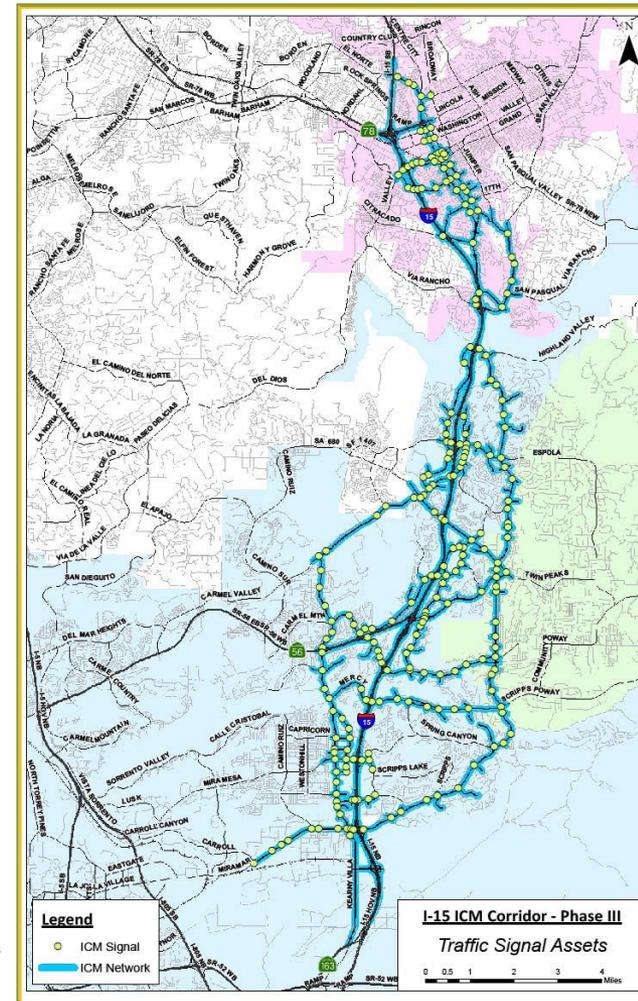
ICM Assets

Rapid Routes

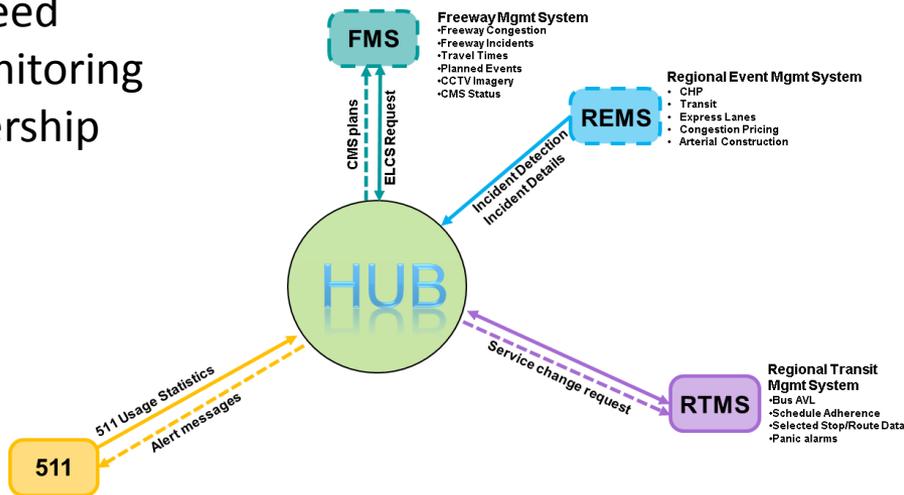
Rapid Express is a weekday, peak-hour service with 10 trips south in the morning and 11 trips north in the evening.



Rapid 235 is an all-day service, 5 a.m. to 11 p.m. During peak-hours, commuter service will be every 15 minutes. Off-peak service is every 30 minutes.



- Transit location
- Transit speed
- Route monitoring
- Route ridership



ICM Assets

Traveler Information

- No change
- Notify operators of event
- Notify public of event on freeway
- Notify public of event on arterial
- Direct traffic to use alternative routes
- Direct traffic to specific routes or transit usage

Traffic Signal Timing

- No action
- Inbound Shoulder
- Inbound Peak
- Inbound Step Up
- Inbound Flush
- Outbound Shoulder
- Outbound Peak
- Outbound Step Up
- Outbound Flush

Ramp Metering

- No action
- Meter Off
- Max
- Min

Transit

- No change
- Notify transit dispatcher of event
- Provide transit dispatcher w/ recommended transit user message
- Provide dead-head re-routing recommendation
- Provide in-service re-routing recommendation
- Recommend deployment of stand-by transit vehicles

Express Lanes

- No change
- Open to all Vehicles
- Northbound 3 Southbound 1
- Southbound 3 Northbound 1
- Closed to vehicles (segment)

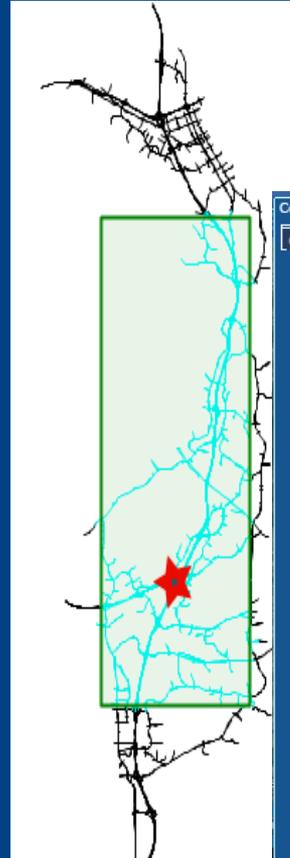
ICM Performance Measures

INPUTS	Caltrans	Local	Transit
Speed	X	X	X
Volume	X	X	
Event Location	X	X	
Headway/Vehicle Location			X
Passenger Counts			X
Parking Availability			X

OUTPUTS	Caltrans	Local	Transit
Speed	X	X	X
Queueing	X	X	
Vehicle Delay	X	X	X
Stops	X	X	
Vehicle Miles Travelled	X		
V/C	X	X	
Travel Time	X	X	X
Level-of-Service		X	
Travel Time Reliability			X

Response Plans: Performance Driven

1. Bounding Box – size defined by response posture to identify minimum selection set
2. LOS Comparison – to identify additional links where response plan implementation has changed operations within the network



Corridor

Global | Asset Availability | Strategy Matrix | Sim Q | Corridor Score | Transit | RP Expiration Ti

Response Plan Improvement		25.0 %			
Evaluation Area		Conservative	Moderate	Aggressive	
"Upstream 1x/Downstream 3x Length Bound"	X	0.5 mi	1.0 mi	1.5 mi	
"Lateral Width Bound"	Y	1.0 mi	2.0 mi	3.0 mi	
Vehicle Occupancy Factors	SOV		HOV	Truck	Bus
		1.0	2.3	1.5	25.0
Evaluation Interval Factors	15 Min		30 Min	45 Min	60 Min
		0.20	0.40	0.20	0.10
Include LOS Processing?		<input checked="" type="checkbox"/>			
LOS Comparison		30 Min			
LOS Exclusions		<input checked="" type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
				<input type="checkbox"/> E	

Save Cancel

Response Plans: Performance Driven

$$\text{Person-Delay per link} = (SV_{SOV} + HV_{HOV} + TV_{Truck} + BV_{Bus}) * D_{Avg}$$

$$D_y = (W_{15} * D_{15}) + (W_{30} * D_{30}) + (W_{45} * D_{45}) + (W_{60} * D_{60})$$

- W_{15} = 0-15 minute weighting factor
- W_{30} = 15-30 minute weighting factor
- W_{45} = 30-45 minute weighting factor
- W_{60} = 45-60 minute weighting factor
- $W_{15} + W_{30} + W_{45} + W_{60} = 1$

$$\text{Corridor Score} = \frac{D_0 - D_z}{D_0} * 100$$

y corresponds to the response plan evaluated:

- 0 = Do Nothing
- 1 = Response Plan A
- 2 = Response Plan B
- 3 = Response Plan C

- D_0 = Person-delay under Do Nothing Case
- z corresponds to the Proposed Response Plan (s)

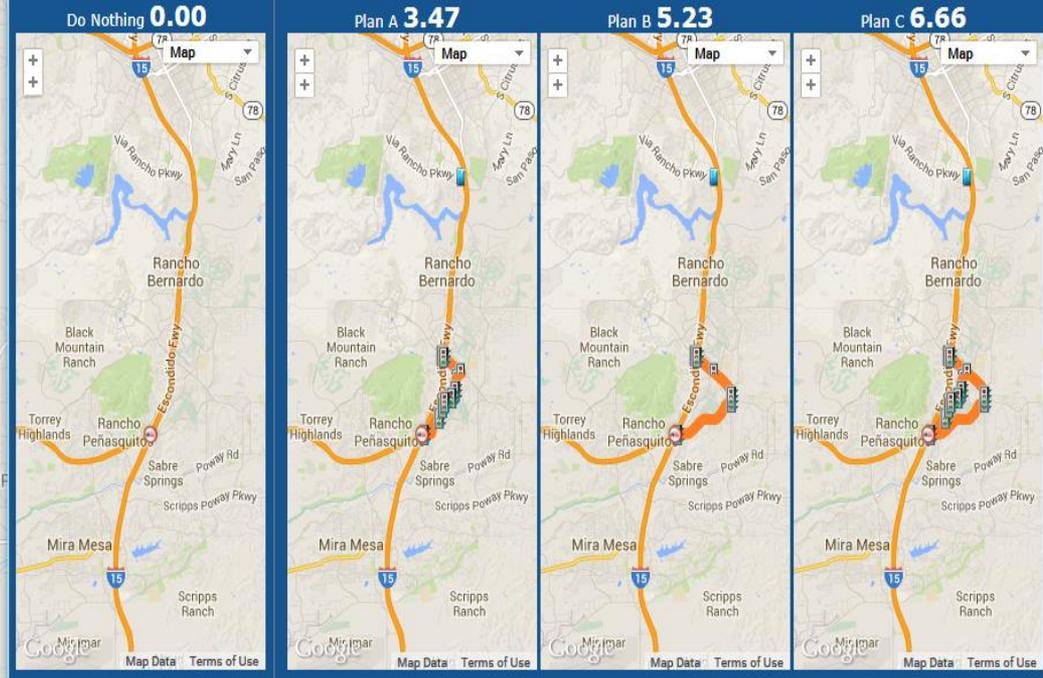
Viewer | Confirmed Event 625977 : I-15 S at TED WILLIAMS FREEWAY (SR-56)

Event Basics | Notes | Details | Geolocator | Response Plans

Show Predictions Assets Diversions

2014-06-02 08:20

Predictions: Time (minutes) 15 30 45 60 Color Prediction By LOS V/C Speed



- Evaluations
- Plan A
- Plan B
- Plan C

2014-06-02 08:19
 Caltrans
 I-15 S at Camino Del Norte

Sign ID: CMS 37
 Status: Not in Queue
 RP (Active):
 RP (Queue):

**ACCIDENT
 EXPRESS LANES
 OPEN TO ALL**

SB 15 At Camino Del Norte | Caltrans | View Only
 Status: OK | 2014-06-02 08:21:37



Status: OK | I-15 S at Camino Del Norte | Mozilla

Video Size | Open Presets

ZOOM FOCUS IRIS

CCTV Events Parking Radio Ramp Sign Signal Toll Transit VDS Weather

ICMS Control Canceled
 Unavailable

Precipitation
 Rain Light
 Rain Moderate
 Rain Heavy

Open Icon Layering
 Close Legend

ICM Response Plan - DSS

Inventory + Prediction

1



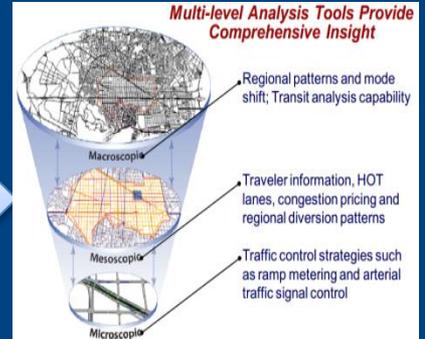
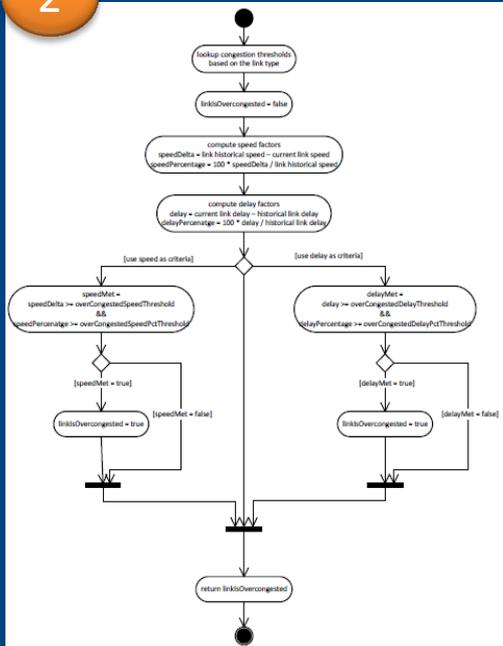
Event Response Suite

3



Business Rules Engine

2



4

Corridor MOE

5

{0.00, -13.28, 11.14, 1.19, 7.81, 2.2}

Recommended Response Plan

6



So What is Happening Now?

- SANDAG; Caltrans; cities of San Diego, Poway, and Escondido; NCTD; and MTS are working together
- ICM system allows partners to address congestion in real-time, holistically under 'normal' and incident conditions
- Active Arterial Routing Strategy Implementation

Coordinated Operations

□ Operational review meetings

□ Venue to check in and review system operations

- Events and response plans occurring in past period
- Performance statistics associated with events
- Expectations regarding event identification and appropriate responses
- Corridor configuration parameters (particularly congestion score, congestion event finder, congestion thresholds)

- Aim to foster an on-going process for discussing, reviewing, assessing, and ultimately modifying ICM system settings and response plans



Baseline Establishment: Understanding Response Plans

Date	Tuesday, June 30, 2015		Event ID:	853963	
Response Plan ID:	31039		Score:	6.6	
Begin	End	Duration	Severity	Dir	Post Mile
2:34 PM	3:30 PM	55mins,51sec	Major	NB	23.9

SUMMARY

@	3:04 PM	
Roadway	Event Location	Description
I-15 N	Rancho Bernardo Rd.	Congestion on North I-15 near Rancho Bernardo Rd. Consider alternate route.

PROPOSED CHANGE LIST:
DIVERSION: Exit at Ted Williams to Pomerado North and re-enter at Pomerado on ramp

ID	NAME	CURRENT	PROPOSED
Poway.24	Pomerado Hospital @ Pomerado	6A	6A
Poway.38	Pomerado @ Casa Avenida	Free	6A
Poway.54	Pomerado @ Monte Vista	6A	6A
Poway.21	Ted Williams @ Pomerado	Free	6A
Poway.22	SR-103 Colony Drive @ Pomerado	Free	6A
Caltrans.135	I-15 @ POMERDO HIGHLAND	Free	Free
Caltrans.126	I-15 @ TED WILLIAMS PKWY	2A	2A
SanDiego.1119	Greens East @ Pomerado	6A	6A
SanDiego.1118	Oaks North @ Pomerado	6A	6A
SanDiego.1116	Mirasol @ Pomerado	6A	6A
SanDiego.1115	Escala @ Pomerado	6A	6A
SanDiego.1114	Highland Valley @ Pomerado	Free	6A
SanDiego.1124	Bernardo Heights @ Pomerado	2A	6A
SanDiego.1122	Higa Place @ Pomerado	2A	6A
SanDiego.1123	Pomerado @ Stone Canyon	6A	6A
SanDiego.1241	Paseo Del Verano @ Pomerado	Free	6A

PROPOSED CHANGE LIST:

ID	NAME	DIR	CURRENT vplph (Rate Code)	PROPOSED vplph (Rate Code)
RMIS.12704	Pomerado/W Bernardo	NB	996 (1)	996 (1)
RMIS.12602	Bernardo Center Dr	NB	461 (15)	461 (15)

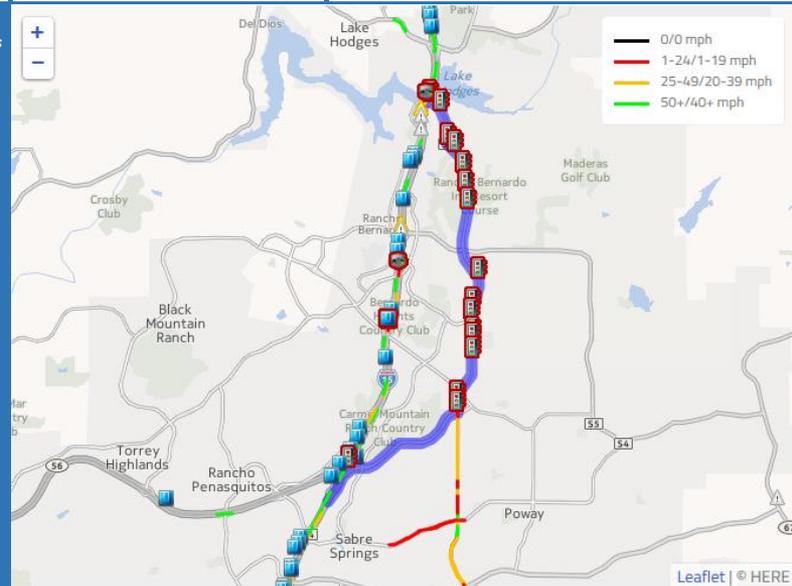
APPROVED LIST:

ID	NAME	DIR	CURRENT	PROPOSED
CMS 36	Camino Del Norte	NB		SLOWING AT RANCHO BERNARDO EXPECT DELAYS

Traffic Signals
16

Ramp Meters
2

CMS
1



I-15 North at JSO Camino Del Norte

C80 NB15 JSO CAMINO DEL N 06-30-15 15:16:42 C80 NB15 JSO CAMINO DEL N 06-30-15 15:27:49



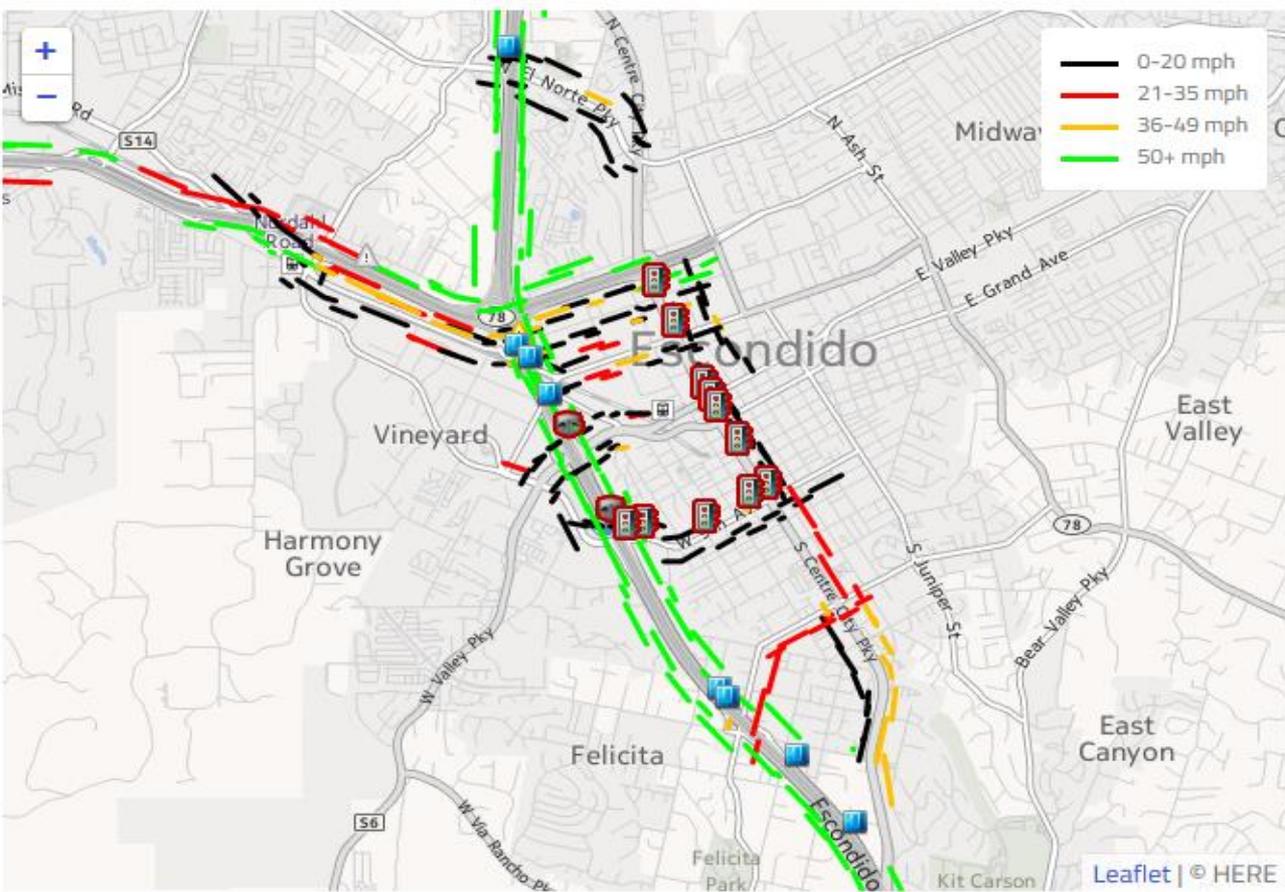
511 Message: Congestion on north I-15 near Rancho Bernardo Rd. Consider alternate routes including Exit at Ted Williams to Pomerado North and re-enter at Pomerado on ramp.

Notes:
 Data along the response plan generated arterial route shows a clear increase in vehicle flow. This increase in flow, however, shows no negative impact on the speeds or travel times, as is demonstrated by INRIX data along Ted Williams Pkwy and Pomerado Rd. Travel time remains relatively consistent to normal day operations for that route. Reasons behind a lack of improvement in travel time along the route could be attributed to weather conditions (rain and thunderstorms) during that time frame. Heavy rainfall began approximately around 2:30pm which is when the event was generated. Event did not trigger until 3pm, however, once congestion had accumulated along the I-15 North.

Response Plan Analysis Tool

	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM
INCIDENTS	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️	⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️ ⚠️
SANDAG INCIDENTS			⚠️		⚠️ ⚠️		⚠️
RESPONSE PLANS					⋮		⋮

Measured



Details

- 17:35 Response plan ID :19539 NS
- 17:48 Response plan ID :19535 -1.7
- 17:48 Response plan ID :19535 -1.7
- 17:48 Response plan ID :19536 21.1
- 17:48 Response plan ID :19535 -1.7
- 17:48 Response plan ID :19536 21.1

LOCALTIME 07/07/2014 17:48
 RESPONSE PLAN ID 19536
 EVENT ID 639956
 SCORE STATUS activated
 SCORE 21.068744

3 DMS were affected

Caltrans-D11.1120662
 STATUS: proposed
 ACTION PLAN ID: 211551
 COMMAND: put up custom message
 MESSAGE:

**SLOWING AT
RTE 78
USE ALT**

Caltrans-D11.1120662
 STATUS: proposed
 ACTION PLAN ID: 211551
 COMMAND: put up custom message

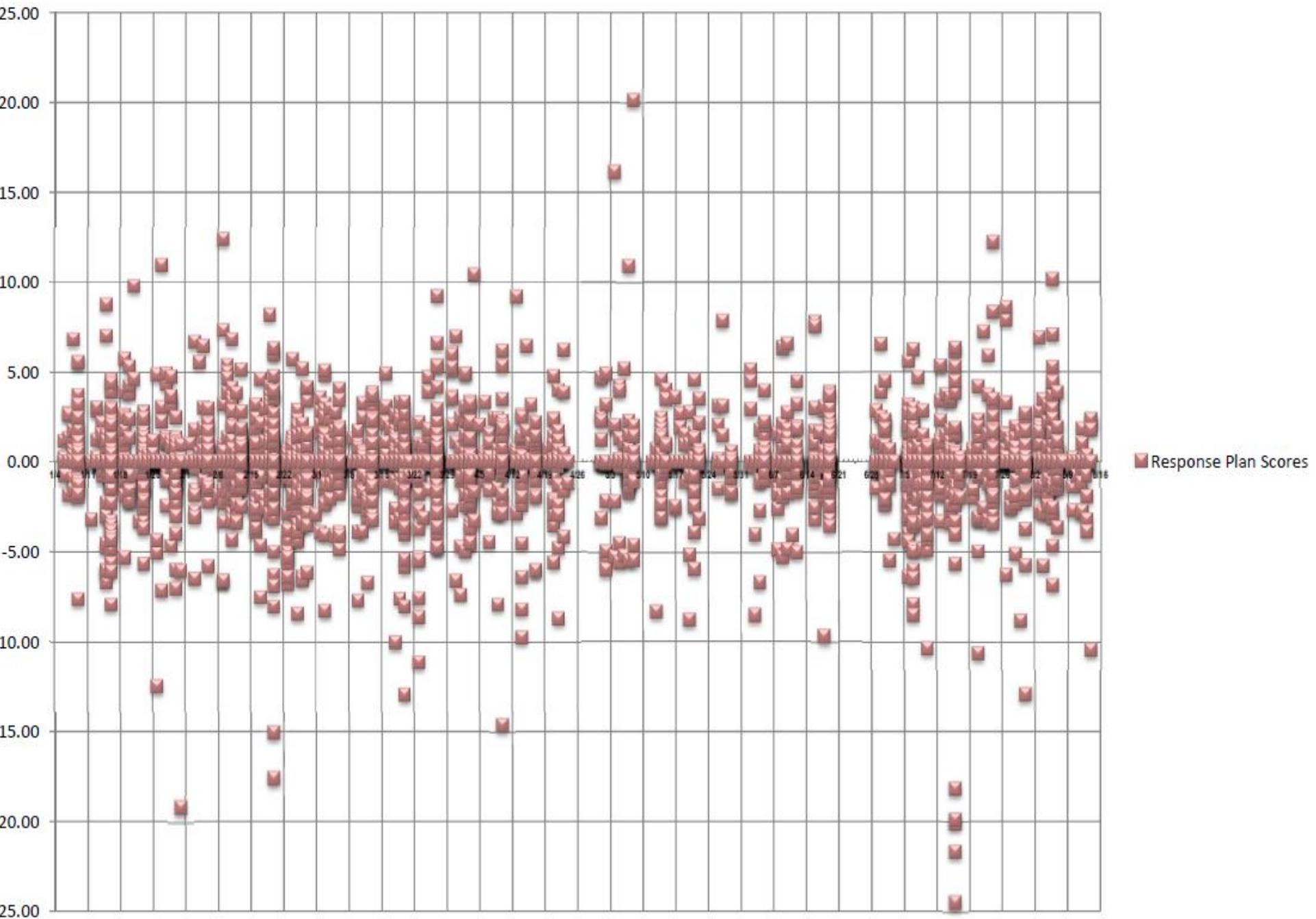
Southbound AM Peak 6:00AM-10:00AM

Count	Date	Event ID	Start Time	End Time	Duration	Score	Location	Congestion/Caltrans
SB1	4-May-15	802231	8:39 AM	8:53 AM	14	16.13	N. Hale/W. Washington Ave.	Congestion
SB2	7-May-15	804238	8:34 AM	9:09 AM	35	10.9	Pomerado Road/Miramar Road	Congestion w/Caltrans
SB3	8-May-15	804951	8:44 AM	8:53 AM	9	20.15	N. Hale/W. Washington Ave.	Congestion
SB4	27-May-15	817649	8:34 AM	8:53 AM	19	7.74	N. Hale/W. Washington Ave.	Congestion
SB5	10-Jun-15	842450	8:34 AM	8:53 AM	19	6.49	N. Hale/W. Washington Ave.	Congestion
SB6	24-Jun-15	850170	8:34 AM	8:49 AM	15	10.01	N. Hale/W. Washington Ave.	Congestion
SB7	7-Jul-15	857210	9:33 AM	9:43 AM	10	6.3	N. Hale/W. Washington Ave.	Congestion
SB8	3-Aug-15	874246	5:53 AM	7:09 AM	76	6.91	Rancho Bernardo Road	Congestion w/Caltrans
SB9	28-Aug-15	889056	6:34 AM	9:09 AM	155	6.4	Via Rancho Parkway	Congestion w/Caltrans
SB10	15-Sep-15	899273	7:44 AM	7:59 AM	15	8.02	N. Hale/W. Washington Ave.	Congestion
SB11	15-Sep-15	899361	8:34 AM	8:49 AM	15	10.4	N. Hale/W. Washington Ave.	Congestion
SB12	13-Oct-15	918438	8:19 AM	8:39 AM	20	8.22	Gamble/Felicita	Congestion
SB13	26-Oct-15	927243	7:24 AM	8:09 AM	45	6.06	S. Auto Parkway/9th Avenue	Congestion
SB14	6-Jan-16	971815	7:39 AM	7:49 AM	10	9	N. Hale/W. Washington Ave.	Congestion
SB15	25-Feb-16	1004035	6:10 AM	8:10 AM	120	6.6	Gamble/Felicita	Congestion w/Caltrans
SB16	4-Mar-16	1009458	8:09 AM	8:24 AM	15	7.3	Gamble/Felicita	Congestion
SB17	8-Mar-16	1012337	8:34 AM	8:49 AM	15	6.9	N. Hale/W. Washington Ave.	Congestion

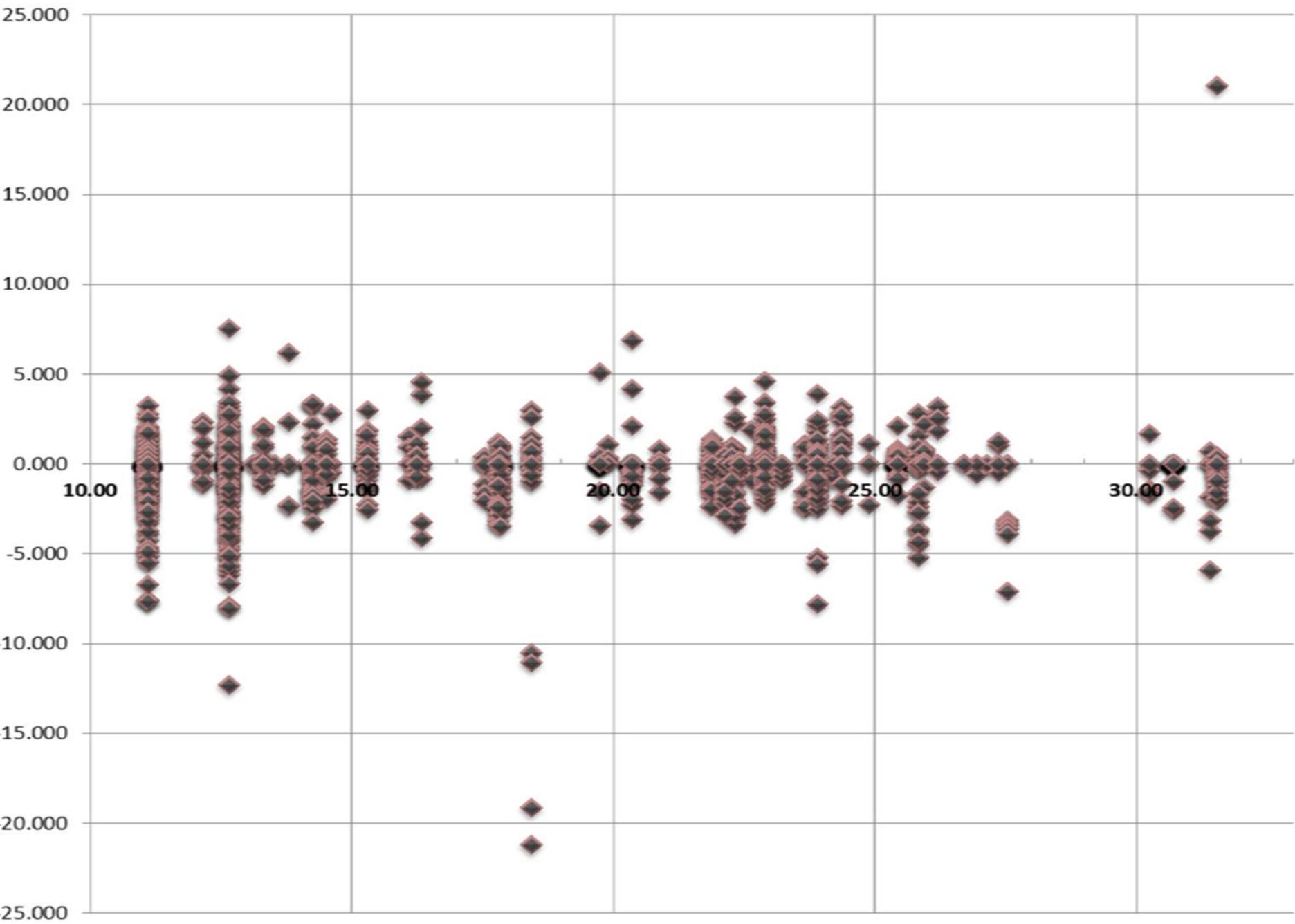
Northbound PM Peak 3:00PM-7:00PM

Count	Date	Event ID	Start Time	End Time	Duration	Score	Location	Congestion/Caltrans
NB1	9-Jun-15	842085	3:44 PM	3:59 PM	15	6.31	Mira Mesa Boulevard	Congestion
NB2	16-Jun-15	845922	4:00 PM	6:48 PM	168	7.7	Duenda Road	Congestion
NB3	30-Jun-15	853963	2:34 PM	3:30 PM	56	6.6	Rancho Bernardo Road	Congestion w/Caltrans
NB4	22-Jul-15	867834	7:03 PM	7:13 PM	10	7.2	N. Hale/W. Washington Ave.	Congestion
NB5	27-Jul-15	870595	3:54 PM	4:24 PM	30	8.57	Miramar/Pomerado Road	Congestion w/Caltrans
NB6	6-Aug-15	876760	5:19 PM	6:33 PM	74	7.1	Bernardo Center Drive	Congestion
NB7	6-Aug-15	876760	5:19 PM	6:33 PM	74	10.2	Bernardo Center Drive	Congestion
NB8	28-Jan-16	986027	3:14 PM	3:29 PM	15	9	Mira Mesa Boulevard	Congestion

Response Plan Scores by Date (after 1/1/15)



Response Plan Scores by Event Milepost - Northbound



TSMO and ICM

MOUs



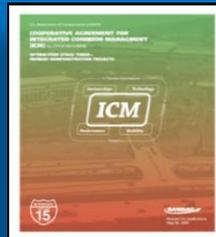
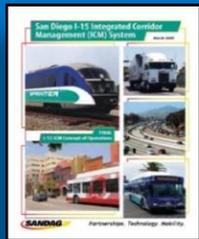
Management Framework



Technical Memorandum

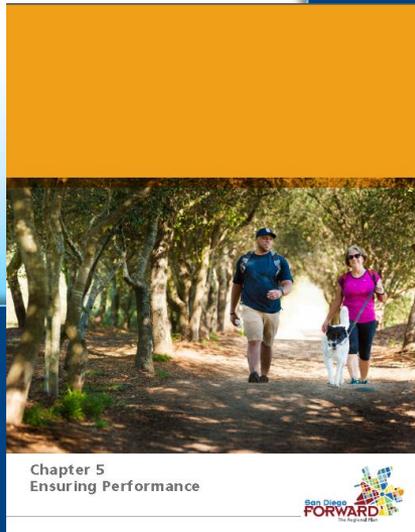


Common Vision – Management/Operations – Day to Day Operations



- Establish Institutional Commitment/Strengthening Partnerships
- Performance Based (Common Vision) – Multi-Modal Operations and Management
- Technical Integration – ICM serves as technical tool/vehicle
- Establish Long Term Strategic Vision

Next Steps:



- Actions to Implement Plan
 - Next ICM Corridors - Develop Next Concept of Operations
 - TSMO Plan

- More Info/Questions:
Alex Estrella –
Alex.Estrella@Sandag.org

www.sandag.org/ICM