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**Fog Detection and  
Warning System  
(FDWS)**



# **Fog Detection and Warning System (FDWS)**

Presenter

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California Department of Transportation

T3 Webinar

John Liu

01.30.2013

DDD-Caltrans



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**Fog Detection and  
Warning System  
(FDWS)**



# Presentation Topics

**Purpose**

**Radiation | Tule Fog**

**Original Concept**

**Lessons Learned from CAWS and Other Systems**

**FDWS Overview**

- Technical Approach
- Data Flows
- Field Hardware
- Central Control System – Cameleon
- Outreach

**Ongoing Issues | Concerns**

**What's Next?**

**Questions**

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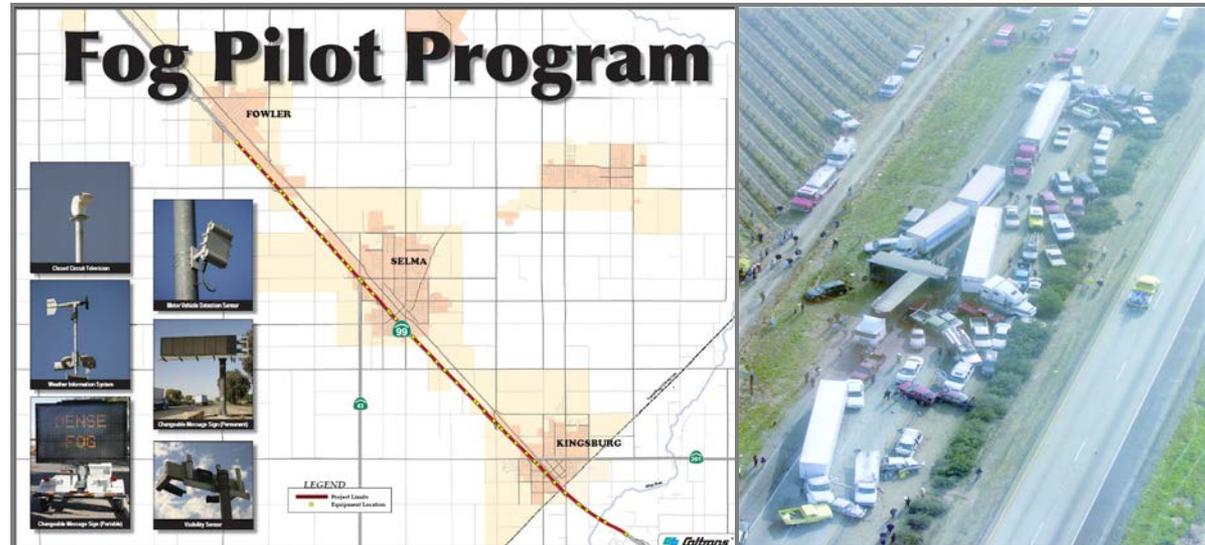
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## Fog Detection and Warning System (FDWS)



## Purpose

The imperative to eliminate or minimize deadly multi-vehicle accidents during the San Joaquin Valley's Winter/Fog Season, along a 12-mile stretch of State Route 99 in Fresno and Tulare Counties.



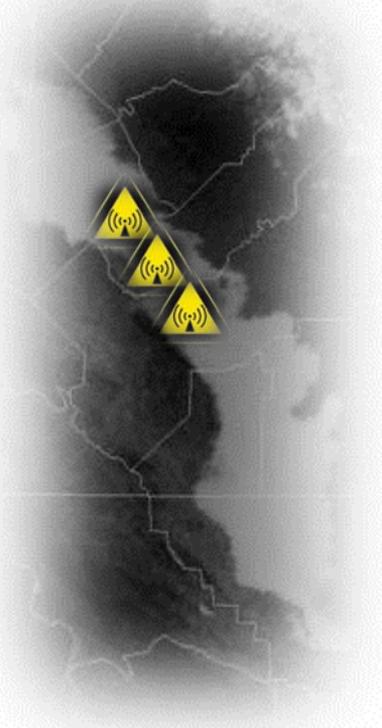
November 3, 2007 crash involving 81 vehicles including 11 big rigs, 2 fatalities, and 68 injuries



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## Fog Detection and Warning System (FDWS)

- # Radiation | Tule Fog
- Forms day or night under clear skies with calm winds
  - Heat is absorbed by the earth's surface during the day is radiated into space
  - As the surface continues to cool, provided a deep layer of moist air is present, the humidity will reach 100%
  - Varies in depth from 3 feet to about 1,000 feet
  - Always found at ground level and usually remains stationary
  - Reduced visibility to near zero at times - making driving very hazardous



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- Speed data from sensors and commercially available sources
- GPS for vehicle locations
- Smart phones to warn for stopped traffic



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## Fog Detection and Warning System (FDWS)



# CAWS and Other Systems



D10 CAWS - Caltrans Automated Warning Systems (1996)



Operation Fog Variable Speed Pilot Project (2003)



CVTMC - Operation Fog | CHP Pace Program (1992)



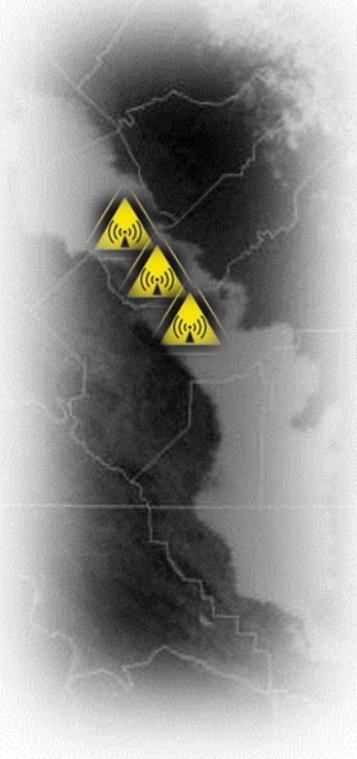
Tennessee Low Visibility Warning System (1994)

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## Fog Detection and Warning System (FDWS)



# FDWS Overview Technical Approach

### Detection

Visibility (Fog)

Traffic (Presence | Speed)

Microwave Vehicle Detection System (MVDS)



### Advanced Warning

Changeable Message Signs (CMS)

Smart-Extinguishable Message Signs (EMS)

Highway Advisory Radio (HAR)



### Verification (Visual)

CCTV



### Field Communications

### Central Control System

Cameleon





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## Fog Detection and Warning System (FDWS)



# FDWS Overview

## ITS Elements

- 29 FCMS-Standard
- 4 FCMS-Color
- 6 PCMS
- 41 MVDS
- 22 Visibility Sensors
- 11 CCTV-Standard
- 2 HAR-BlackMax

## Cost

\$12 Million

## Prime Contractor



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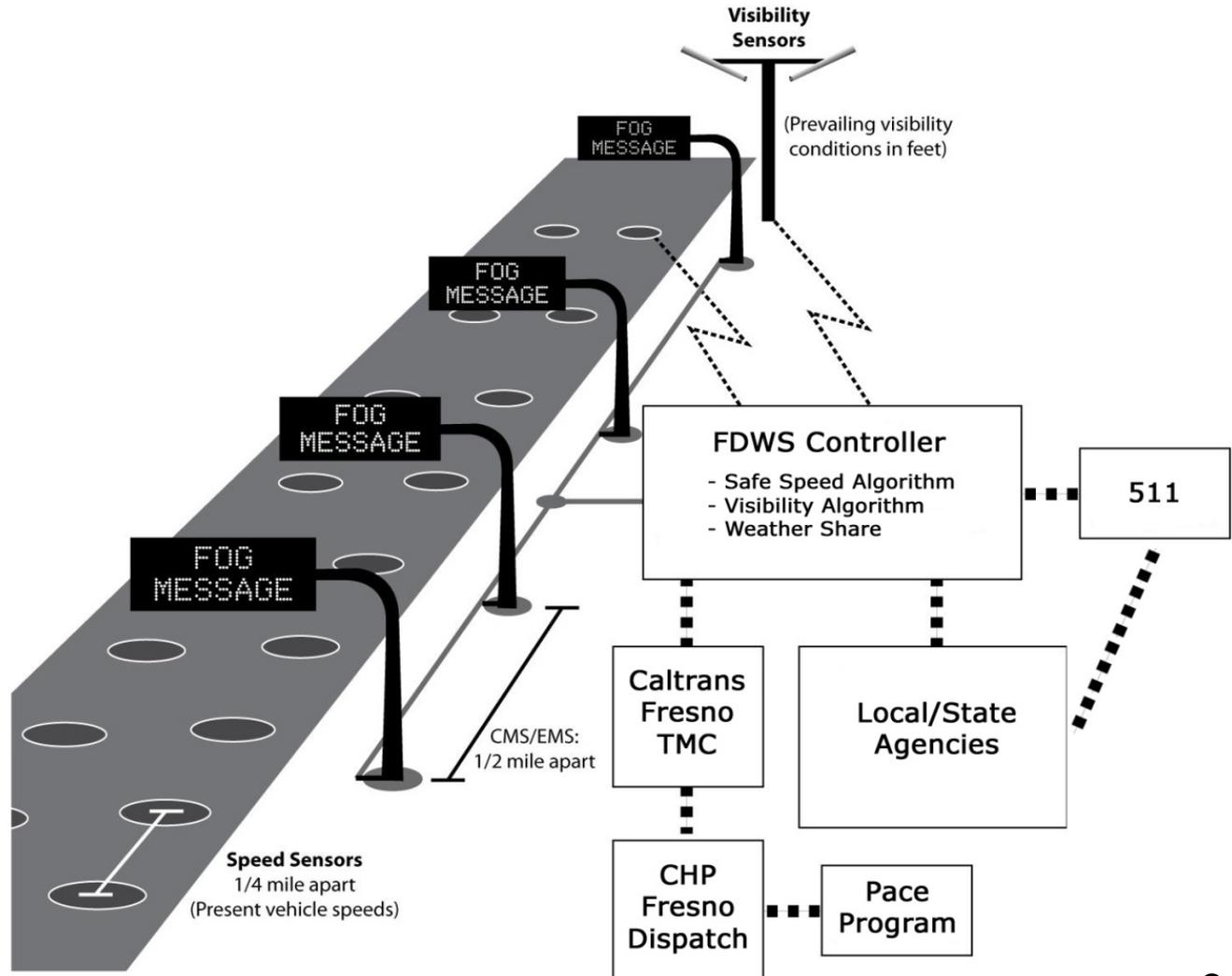


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# Fog Detection and Warning System (FDWS)



## FDWS Overview Data Flows



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# Fog Detection and Warning System (FDWS)



# FDWS Overview – CMS Message Priority

Priority	Conditions	Warning Message
0	None of the following	Sign is blank
1	200' ≤ VISIBILITY < 800' AND SPEED ≥ 45	<b>FOG AHEAD</b>
2	0 ≤ VISIBILITY < 200' AND SPEED ≥ 45	<b>DENSE FOG AHEAD</b>
3	CHP_PACE AND SPEED ≥ 45	<b>DENSE FOG CHP PACE DO NOT PASS</b>
4	VISIBILITY < 800' AND 35 ≤ SPEED < 45	<b>FOG AHEAD TRAFFIC SLOWS TO 40 MPH</b>
5	VISIBILITY < 800' AND 25 ≤ SPEED < 35	<b>FOG AHEAD TRAFFIC SLOWS TO 30 MPH</b>
6	VISIBILITY < 800' AND 15 ≤ SPEED < 25	<b>FOG AHEAD TRAFFIC SLOWS TO 20 MPH</b>
7	VISIBILITY < 800' AND 5 ≤ SPEED < 15	<b>FOG AHEAD TRAFFIC SLOWS TO 10 MPH</b>
8	VISIBILITY < 800' AND 0 ≤ SPEED < 5	<b>STOPPED TRAFFIC AHEAD</b>

Where, for a given CMS:  
 VISIBILITY is the minimum visibility detected in a zone and the adjacent zone in each direction.  
 SPEED is the minimum speed of downstream traffic in the same zone.  
 CHP\_PACE is an operator input indicating that CHP Pace program is in effect.

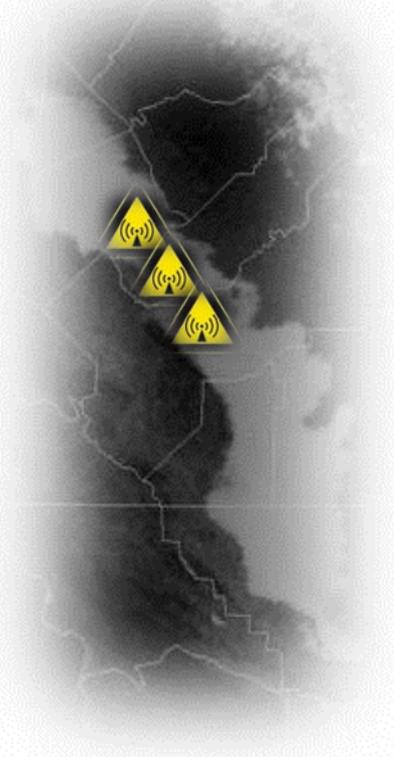
Note: messaging shown for Permanent CMS

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## FDWS – Detection Visibility

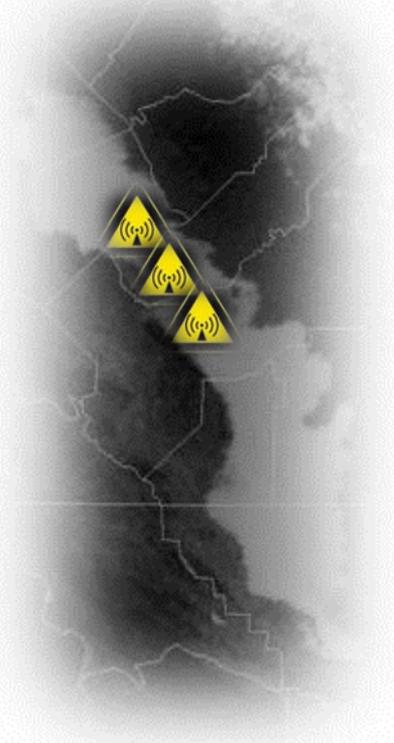
- Density-deploy enough sensors to detect localized fog pockets
- Deploy off-the-shelf standalone sensors that provide estimated visibility distance
- Sensors do not require periodic recalibration





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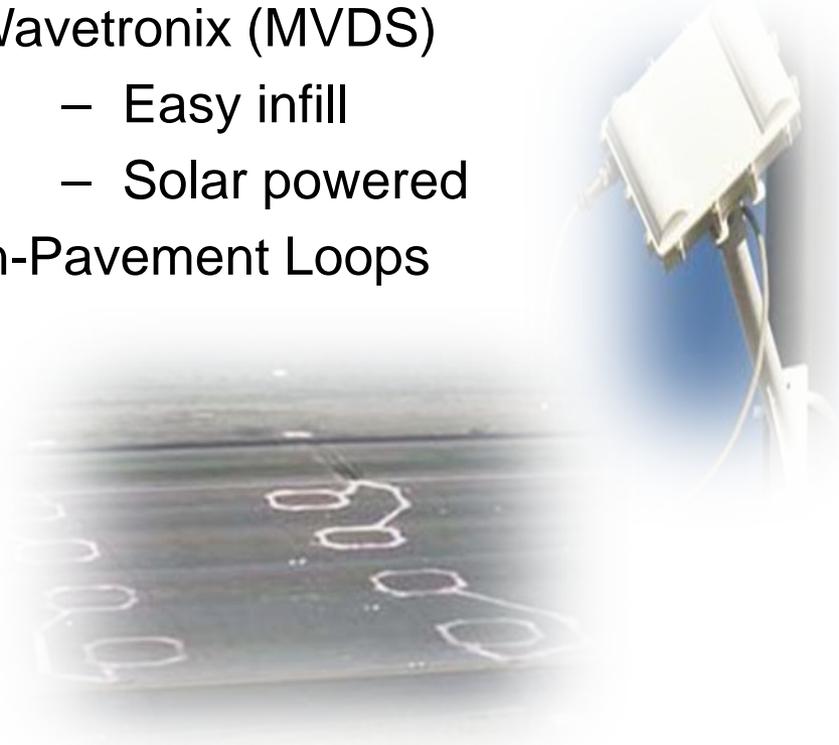


# FDWS – Detection Traffic Presence | Speed

Wavetronix (MVDS)

- Easy infill
- Solar powered

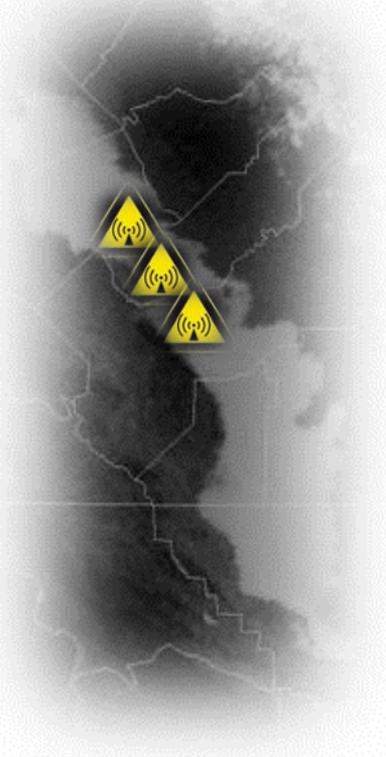
In-Pavement Loops





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# FDWS – Advanced Warning Signage

## Fixed and Portable CMS

- Addco Brick
- Daktronics Color
- Legacy Model 500



## Addco Trailer-Mounted PCMS

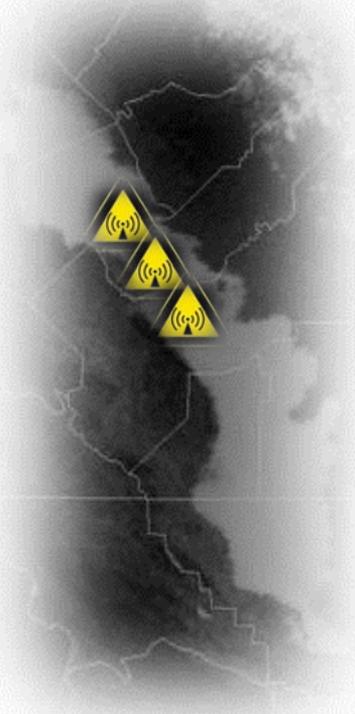


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# FDWS – Advanced Warning Highway Advisory Radio

Enhance existing corridor deployments

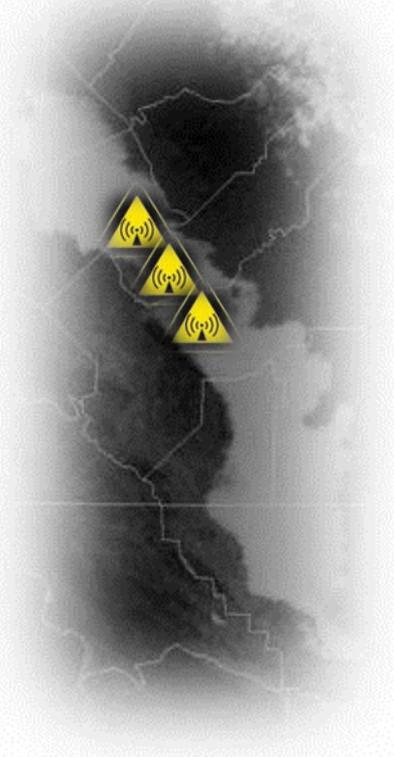
- Reduce/eliminate null near Tulare County
- Synchronize broadcast to create (near) seamless coverage
- Update field/TMC technology to IP-based devices
- Utilize EMS for enhanced/smart messaging





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## Fog Detection and Warning System (FDWS)



# FDWS – Verification CCTV

## Verification

- Pelco 35x Zoom Esprit Camera
- 7 pixels per meter (ppm) at ½ mile





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## Fog Detection and Warning System (FDWS)



# FDWS

## Field Communications

### PLC Architecture (Programmable Logic Controllers)

- Proven in D11 – I-15 Reversible Lane Control System
- Autonomous field operations in the event of communication loss to the central control system
- PLCs interface to Cameleon Central Control System in TMC
- Communications via Ethernet TCP/IP

### Wireless Communications w/Backhaul

- Supports high bandwidth operations
- CCTV and element to element control
- Central Control System to field

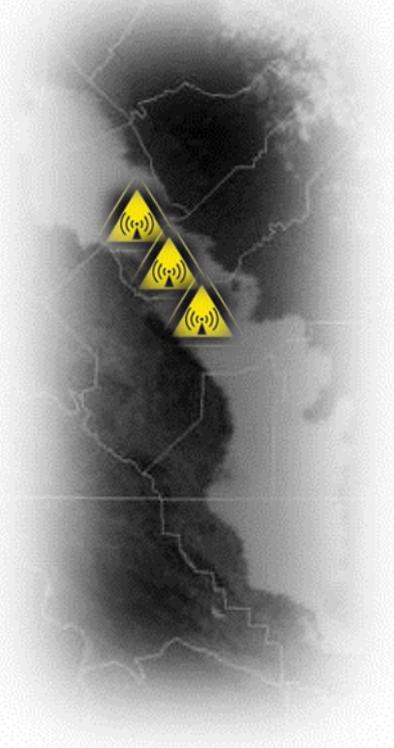


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# FDWS - Central Control System Cameleon

- Advanced Scripting / Full System Automation
- Reliable and Scalable ITS Solution
- Off-The-Shelf Functionality
- Device Priority Control Management
- Dynamic Message Sign Control
- NTCIP Support
- Alarm / Event Management
- Full Logging and Trending Capability
- Configurable Desktop
- Multiple Monitor Configurations
- Customizable Site Maps

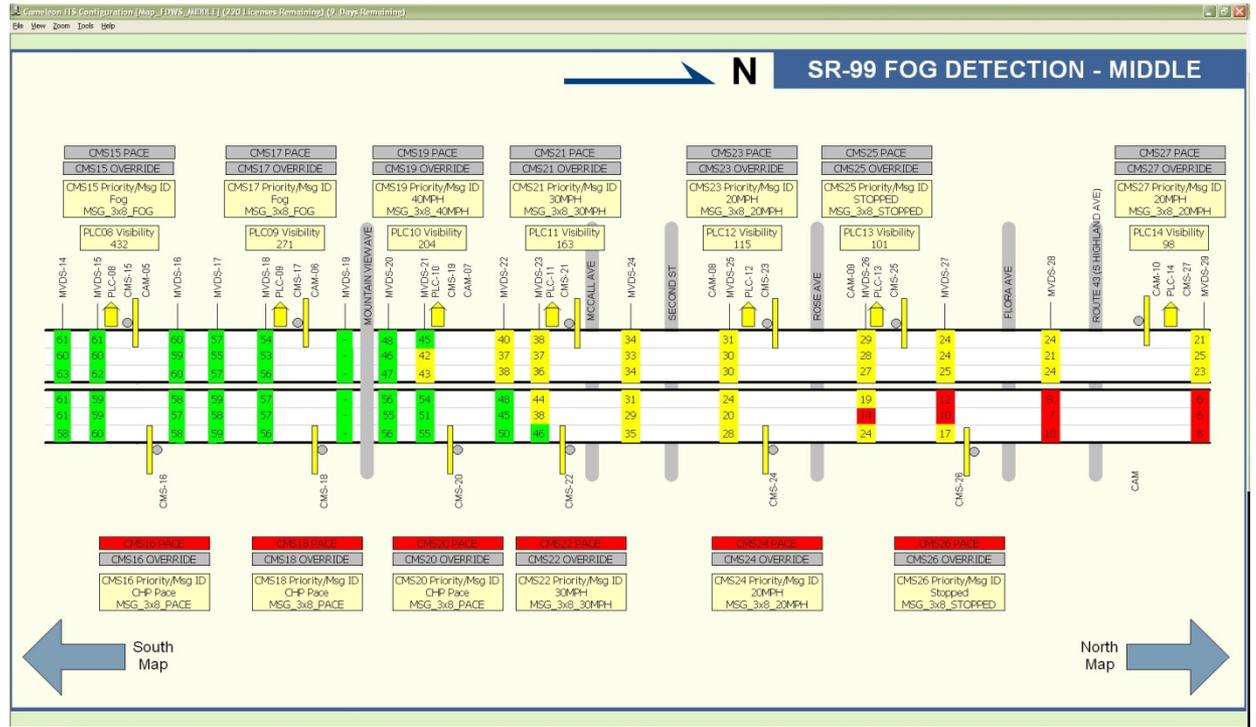


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# Fog Detection and Warning System (FDWS)

# FDWS - Central Control System Cameleon



Customizable Site Maps



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# FDWS – Outreach [www.foguniversity.com](http://www.foguniversity.com)



- Web
- PIO/Media (Modern Marvels)
- Billboard

12/18/2009 11:11



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# Fog Detection and Warning System (FDWS)



# FDWS – Outreach

www.511.sjv

The screenshot shows the 511 San Joaquin Valley website interface. At the top, there is a navigation menu with links for Home, Traffic, Public Transportation, Rideshare, Bicycling, Travel Links, and Partners. The main content area is divided into several sections:

- AccuWeather.com:** Displays weather for Fresno, CA. Current temperature is 48°F. Forecast includes: Tonight (Mainly clear, fog late), Tomorrow (Partly cloudy, cold, fog late), Thursday (Partly cloudy and chilly), and Friday (Overcast, a shower possible).
- Radar:** Shows a radar map of the San Joaquin Valley with various cities marked.
- Map:** A Google Map of the Fresno area with a highlighted route in green and yellow. The route starts near Madera and goes south through Fresno towards Kingsburg.
- Camera Tour:** A video feed showing a camera view of a road at night, labeled "168 at Herndon Ave".
- Google Transit:** A search interface for transit routes. It includes fields for "Start" (ex. Fresno, CA) and "End" (ex. San Francisco, CA), and options to "Depart at" or "Arrive by" a specific date and time.

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# Fog Detection and Warning System (FDWS)



# FDWS – Outreach QuickMap, Apps, Social Media

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Highway Conditions Live Traffic Cameras Amtrak California Caltrans QuickMap Roadside Rest Areas

**Caltrans QuickMap**

- Slow
- Lane Closures
- CHP/CHIN Incidents
- Message Signs
- Cameras
- Chain Controls

Zoom to...

- Redding
- Sacramento
- San Francisco
- Central Valley
- Los Angeles
- San Bernardino
- San Diego

→ QuickMap Mobile

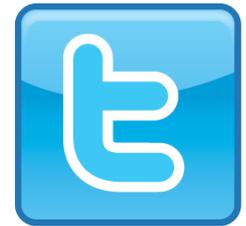
→ QuickMap FAQ

→ Planned Lane Closures

To check conditions, enter highway #  check  
Or call: 1-800-427-7623

**Regional 511 Sites**

- Sacramento
- SF Bay Area
- San Luis Obispo
- San Joaquin Valley
- Los Angeles
- Riverside/San Bernardino
- San Diego



[www.quickmap.dot.ca.gov](http://www.quickmap.dot.ca.gov)

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## Fog Detection and Warning System (FDWS)

# FDWS – Conclusions Ongoing | Concerns | Enhancements

### Concerns

- Recurring Maintenance Cost
- Solar Technology
- Wire Theft
- Additional Fixed Objects Along Roadway

### Enhancements

- Integrate PeMS (Performance Measurement System)
- Automate HAR Activation
- Replace PCMS
- Replace Solar Technology
- Evaluate In-Roadway Lighted Markers
- Perform 3rd Party Evaluation
- Social Media



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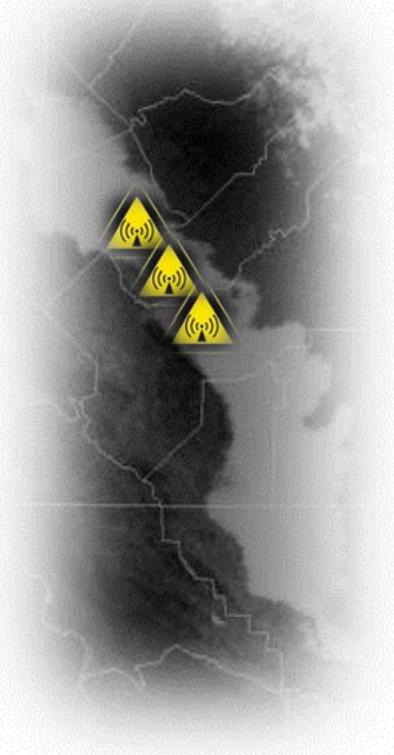
# FDWS – Conclusions What's Next?

- Expand the System?
- Replace with Phone Apps?
- Intelligent Vehicles?



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# Any Questions?

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