Characteristics of Fog-related Accidents

• Fog weather conditions exist in 1.6% of all fatal crashes nationwide.

• Although fog crashes account for a small percentage of all crashes, those crashes usually involve multiple-vehicle pileups and massive losses.

• Fog is a transient phenomena, difficult to predict and variable in density, location, development dissipation rates, and area.

• In fog conditions, drivers often commit errors that contribute to the crash.
Characteristics of Fog-related Accidents

- In 42% of the fog-related crashes, drivers were not issued citations, in part because of the difficulty in witnessing the infraction under reduced visibility conditions. In cases where citations were received, 19% were for driving recklessly, 9% were for failing to yield the right of way, and 5% were for exceeding safe speed.

- The National Transportation Safety Board (NTSB) determined that the one main cause of poor visibility crashes is the non-uniform reaction of drivers.

- Introducing a warning system ahead of the fog conditions increases the time available for reaction, and may improve traffic safety by reducing the speed distribution mean and variance.
CAWS: A Flexible Driver Warning System for a Fog-prone Area

Phase I System Components (from Caltrans Specifications Document)
CAWS Study Area
Stockton-Manteca Area, District 10

Traffic Flow Direction through Study Area

Instrumented Test Section
Qualimetrics Weather Monitoring Station Components (9 Installed)
CAWS Computational, Display and Detection Components

District 10 Traffic Management Center

Meteorological Station Monitoring Computer (Pentium/Win95)

CMS Control Computer (486/DOS)

Traffic (loop detector) Monitoring Computer (486/DOS)

9 Automated remote weather stations

Leased and Dedicated V34 BIS Phone Lines

9 Model 500 Changeable Message Signs

35 Inductive Loop Speed Detectors
Evaluation Objectives

1. Technical Assessment.

2. Operational Assessment.

3. Assessment of impact of system on driver behavior during limited visibility conditions.

4. Assessment of long-term impact of system on accident rates and losses.
Evaluation of Caltrans Automated Warning System

Evaluation Components
Test Sites

French Camp Slough Site

Weather Station 1

First CMS on South-bound I-5

LEGEND

〇 - CHANGEABLE MESSAGE SIGN
△ - WEATHER STATION AND VISIBILITY SENSOR
□ - TRAFFIC MONITORING STATION
Data Acquisition Server
French Camp Slough Site

Linux server with data acquisition subsystem
RS232 Serial Data Stream
Sarasota Model 222 dual-channel inductive loop detection modules
Roadway inductive loops
Qualimetrics visibility sensor and Q-Net interface
RS232
Externally mounted stub antenna
CDPD wireless modem
UPS
110 VAC cabinet power
Discrete OC/TTL outputs of loop detector modules
Data Acquisition Server
Matthews Road Site

- Qualimetrics visibility sensor and Q-Net interface
- Sarasota Model 222 dual-channel inductive loop detection modules
- Roadway inductive loops
- Linux server with data acquisition subsystem
- RS232 Serial Data Stream
- Analog 56kb modem
- UPS
- Discrete OC/TTL outputs of loop detector modules
- 110 VAC cabinet power
CMS Message and Visibility Verification Server
French Camp CMS Site

CMS verification Video Camera, Network-connected

Visibility verification Video Camera, Network-connected

CMS serial command signal, intercepted in controller cabinet

Isolation buffer circuit

Linux data acquisition client

RS232

Analog 56kB modem

Analog telco line
Evaluation System Communications

6 Inductive Loop Outputs from IST 222s

Visibility and day/night sensor

6 Inductive Loop Outputs from Sarasota 222s

Visibility and day/night sensor

2 CCTV camera systems

CMS signal tapped from 170 controller

French Camp Data Acquisition System

County Hospital Data Acquisition System

French Camp CMS Data Acquisition System

IP Video transmission

CDPD wireless to ISP to Internet

Modem to ISP to Internet

Public web access to Evaluation and CAWS web sites

CAWS Evaluation Server at Loragen Corp., San Luis Obispo

CAWS Web Server

Modem to ISP to Internet
## Pre-view Site: Southbound I-5 at French Camp Slough [166.133.71.213]

**Traffic Conditions:** (5 minute averages as of 2002-02-24 15:46:58.64)

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<th>Volume (Veh/Hr)</th>
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**Visibility (extinction coefficient):** 0.36 last data received: Tue Feb 19 11:28:09 PST 2002

## Post-view Site: Southbound I-5 at Matthews Road [216.126.148.89]

**Traffic Conditions:** (5 minute averages as of 2002-02-24 15:47:08.06)

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**Visibility (extinction coefficient):** 0.36 last data received: Tue Feb 19 11:28:09 PST 2002
Camera Site: Southbound I-5 at French Camp CMS [64.24.33.192]

Visibility Verification Image

Sign Verification Image

Last Updated: Sun Feb 24 16:14:09 PST 2002

Secure Access Links

Main Menu
System Status

sysadmin@loragen.com
Problems with loops at French Camp Slough Baseline Site

Speed data unreliable at this Data Acquisition Site.

Extensive tuning work.

Several electronic interfaces used.

Detector cards replaced with advanced adaptive cards.

Ultimately, problem found to be that trailing loop was actually two loops wired in series. Note recorded analog loop signatures:

District working at this moment to isolate one of the two loops for use as the trailing loop in our speed detection system.
Evaluation Test Site Field Work
Accomplishments to date

Preliminary Technical Assessment.
• Site inspections and review of engineering documents completed.

Initial Operational Assessment Tasks.
• Experiment design within strict non-interference constraints. Test site selection and preparation of baseline site. Preliminary validation of evaluation methods via literature survey and networking. Visibility targets and deployment specified. CAWS communications protocols identified experimentally.

Data Acquisition Equipment Designed and Fabricated.
• Specialized hardware and software designed to detect, archive and monitor individual speed and exact time of arrival at each site, as well as visibility, communications with the CMS, and verification of conditions via CCTV cameras. Caltrans secure access and public demonstration access via evaluation web site.

Test Site setup and Equipment Installation.
• Power and communications completed for all DAS sites except French Camp Slough, which uses CDPD wireless communications. Visibility and illuminations level sensors installed on site.

Preliminary Data Collection.
• Data collection started October 2001, although speed data from French Camp Slough remains unreliable at this time.

Comparative Driver Behavior Study.
• Preliminary algorithms for driver behavior assessment developed, but not yet tested pending validation when of field data available.

Assess Long-term Impact of System on Accident Rates.
• TASAS data obtained and analyzed for three years prior to and three years after system actuation. Pre-study report completed at request of Caltrans.
Phase 1 - Program Preparation

1.1 Work with D10 on system access.

1.2 Monitoring software design and implementation.

1.3 Setup of data collection, communications and processing equipment.

Phase 1 Deliverables: Quarter report describing Phase 1 technical activities.
Phase 2 - Implementation

2.1 Setup of instrumentation, communications, and system integration at French Camp and County Hospital field sites.

2.2 Set up remote CCTV monitoring of visibility and traffic conditions at CMS midpoint site.

2.3 Set up remote TMC system access (if required).

2.4 Set up District 10 / CAWS Web site (optional).

Phase 2 Deliverables: Completed field instrumentation. CCTV installation at a selected location in CAWS study area. Internet-based remote network access service. Optional CAWS web site and links. Quarter Report describing Phase 2 activities and accomplishments.
Phase 3 - Real-time Data Collection and Analysis

3.1 Operation, maintenance and field service.

3.2 Data collection, archiving, processing, and interpretation.

Phase 3 Deliverables: Technical support for field instrumentation installed by evaluation team. Quarter report(s) describing data collection activities and reporting preliminary results, observations and limitations.
Phase 4 - Archival Data Collection and Analysis

4.1 Assess operational issues.

4.2 Crash data statistical analysis.

Phase 4 Deliverables: Statistical analysis of archived and current traffic incident data, as described above. Quarter Report discussing operational issues, if any, as described above.
Phase 5 - Long-term Monitoring Infrastructure

5.1 Long-term data collection system design.

5.2 Configure system for autonomous operation.

Phase 5 Deliverables: Design and installation of means (to be determined in consultation with Caltrans) for permanent automated means for data collection, archiving and processing. Quarter Report describing Phase 5 activities and accomplishments.
Phase 6 - Report and Dissemination of Results

6.1 Quarter reports.

6.2 Publication of methodologies and results.

6.3 Draft, 6.4 Final report preparation.

6.5 Draft, 6.6 Caltrans and OTS review, revision and approval of final report.

Phase 6 Deliverables: Final comprehensive evaluation report. One review and revision cycle. Publication of results, consistent with Caltrans policies.
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