Data quality for Aggregation and Dissemination of DOT Traveler Information: Best Practices

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Disclaimer

The opinions, findings and conclusions expressed in this presentation are those of the authors and not necessarily those of the Western States Rural Transportation Consortium, the California Department of Transportation, or Montana State University.

Abstract

Data quality for traveler information data has generally been handled on an ad-hoc basis, with little or no provision for error notification other than perhaps through user-reporting of observed errors. Weather-related systems such as MADIS, Mesowest and Clarus have applied quality checks to weather sensor data, but these checks don't necessarily transfer to other sensor and data types. Further, these checks may not be applicable to department of transportation RWIS sites in the absence of data from additional sites. Some, including Caltrans District 2, have implemented measures of reliability based on network and file transfer performance. The District 2 Information Relay and the DRISI CWWP2 efforts have also included some checks for bad data in CCTV and other feeds. However, *there do not appear to be unified, multi-dimensional approaches to data quality for aggregation and dissemination of DOT traveler information.*

The goal of this project is to analyze and document existing system best practices for data quality for the aggregation and dissemination of state department of transportation traveler information.

Presentation Outline

- Problem(s)
- Need
- Objectives
- Survey (preliminary responses)
- Literature Search (in progress)
- Next Steps
- What We're Doing
- Acknowledgements

Problem

The quality of data is a crucial consideration for the provision of traveler information. For example, is the data accurate, timely, and reliable?

- Drivers will make travel decisions based on up to date, correct, and accessible information which ultimately impacts the effectiveness of traffic management.
- Drivers are much less likely to access the information and make travel decisions based on information that is incorrect, stale, or untrustworthy. This can significantly diminish the effectiveness of traffic management efforts. Even worse, if drivers use incorrect information to make travel-related decisions, accidents, injury or even death could occur.

Examples of Problems with Traveler Information Data and Metadata

- Meta data – field element location, timestamps
- Old or frozen CCTV images
- Partial CCTV image, dark CCTV image
- Indication of camera being unavailable
- Duplicate data in different locations
- Misspellings on sign messages
- Camera settings visible to the public
- Color display (affects interpretation of road conditions)
- Incidents incorrectly located
- Chain-up control requirements
- RWIS data – e.g., surface temperature, error, missing, displaying a value when there is no sensor, depth and water level
- Incorrect data (temperature, precipitation, etc.)

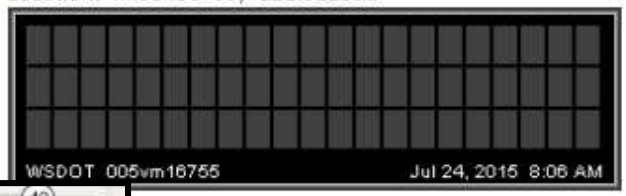
Examples From the One Stop Shop (oss.weathershare.org) 07/24/2015

What problems can we find on an arbitrary day?

WA-005vm16379 at NB @ Walker St
Updated: 8:50 AM MDT - Fri, Jul 24 2015
Location: 47.58379892, -122.31984

Source: WS

WA-005vm16755 at NB @ Lakeview
Updated: 8:50 AM MDT - Fri, Jul 24 2015
Location: 47.63496799, -122.322991



Source: WSDOT

CA-38 at Cisco Grove
Updated: 2:10 PM MDT - Tue, Aug 4 2015
Location: 39.309886, -120.543545
Direction: West

Source: CALTRANS

OR-273 VAS I5 SB @ Ross Island Bridge Right MP299.7
Updated: 7:25 AM MDT - Thu, Jul 16 2015
Location: 45.500596, -122.673855

Source: ODO

OR-39 CWS I84 EB @ Plano Rd MP331.1
Updated: 7:25 AM MDT - Thu, Jul 16 2015
Location: 44.54494671, -117.4193508

Source: ODOT

WA-005tt15034 at NB @ S 216th St
Updated: 8:50 AM MDT - Fri, Jul 24 2015
Location: 47.4083575, -122.292165

Source: WSDOT

CA-823045 at E/O DESERT CENTER
Updated: 8:50 AM MDT - Fri, Jul 24 2015
Location: 33.71024, -115.373882
Direction: West

Source: CALTRANS

OR-23 VMS I84 WB @ Hood River MP65.31
Updated: 7:25 AM MDT - Thu, Jul 16 2015
Location: 45.70702, -121.4848

Source: ODOT

I-5 at Cottage Grove NB

I-5 at Cottage Grove
Updated: Jul 24 2015 8:09 AM Looking North

This image is currently unavailable.

SR-36 @ Village Blvd, STP

This camera has been removed from service due to major construction or damage.
Please check back monthly.

Mile Marker 92.75

The web camera is temporarily under repairs.

Your patience is appreciated.

Source: Wyoming Department of Transportation

I-15 SB @ 15800 S / MP 286.64, BLF

There is no image available from this camera. Please try to access it later. If you receive this message after an hour, it might take us more than one day to repair the problem.

(552) e/o Ford Dry

Image Unavailable

Source: CALTRANS

I-70 @ IDAHO SPRINGS

Image Currently Unavailable

Source: Colorado Department of Transportation

NB @ 12800 S / SR-71 / MP 291.4, DPR

Last camera image missing. Please re-try in a few minutes.

Source: Utah Department of Transportation

Siebert on US 101 @ MP 256

© WSDOT Jul 24, 2015 8:18 AM PDT

Source: WSDOT

This camera is currently offline for repair. We are working to get the camera back online as quickly as possible, but it will be longer than one day.

Source: Utah Department of Transportation

AstoriaUS101Bridge

US101 at Astoria Bridge (North Span)
Updated: Jul 24 2015 8:13 AM

Image unavailable due to Construction

No Stream

ODOT

Elevation 200 TripCheck.com Milepost 3.70
Temperature n/a Wind SW MPH 7

Source: ODOT

SR431 West Side Meadows

US 93 Kaiser Bridge @MP 135.0

Source: Arizona Department of Transportation

I-215 and Warm Springs N

Fairchild looking West

US-101: North of Ridgewood Summit

Shoshone County Line

South Temple St @ Main St, SLC

Source: Utah Department of Transportation

I-15 SB @ 12950 S / MP 290.67, DPR

Source: Utah Department of Transportation

Two Medicine - 3

Source: Montana Department of Transportation

(632) n/o Midway RA

The Dalles

US197 at I-84 - The Dalles

Updated: Jul 24 2015 8:14 AM Looking North

(560) Lovekin Blvd.

Source: CALTRANS

Hwy 101 at Brookings SB

US101 at Brookings

Updated: Jul 24 2015 8:04 AM Looking South

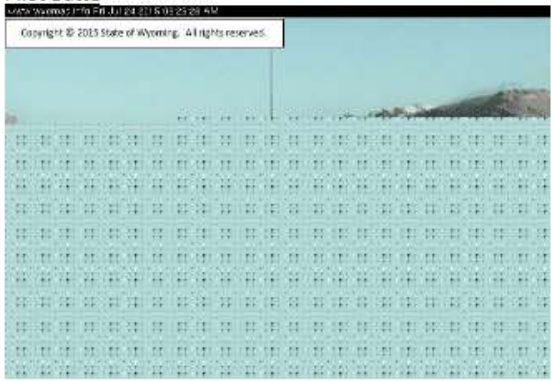
Elevation 150 TripCheck.com Milepost 358.00

Main St / SR-145 @ Kawakami Dr / 600 W, AFK

Source: Utah Department of Transportation

US-101 : North Of SR-36

Pilot Butte



Source: Wyoming Department of Transportation

Source: Utah Department of Transportation

I-15 SB @ University Ave / 2260 S / MP 263, PVO

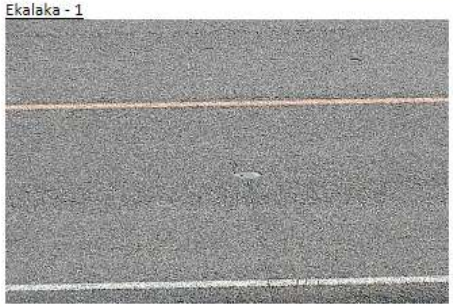
Source: Utah Department of Transportation

N/O RTE 58

Hwy 156 at San Felipe Rd north of Hollister

Sweetgrass - North

Ekalaka - 1



Source: Montana Department of Transportation

I-15 NB @ 800 N / SR-52 / MP 271.7, ORM

Source: Utah Department of Transportation

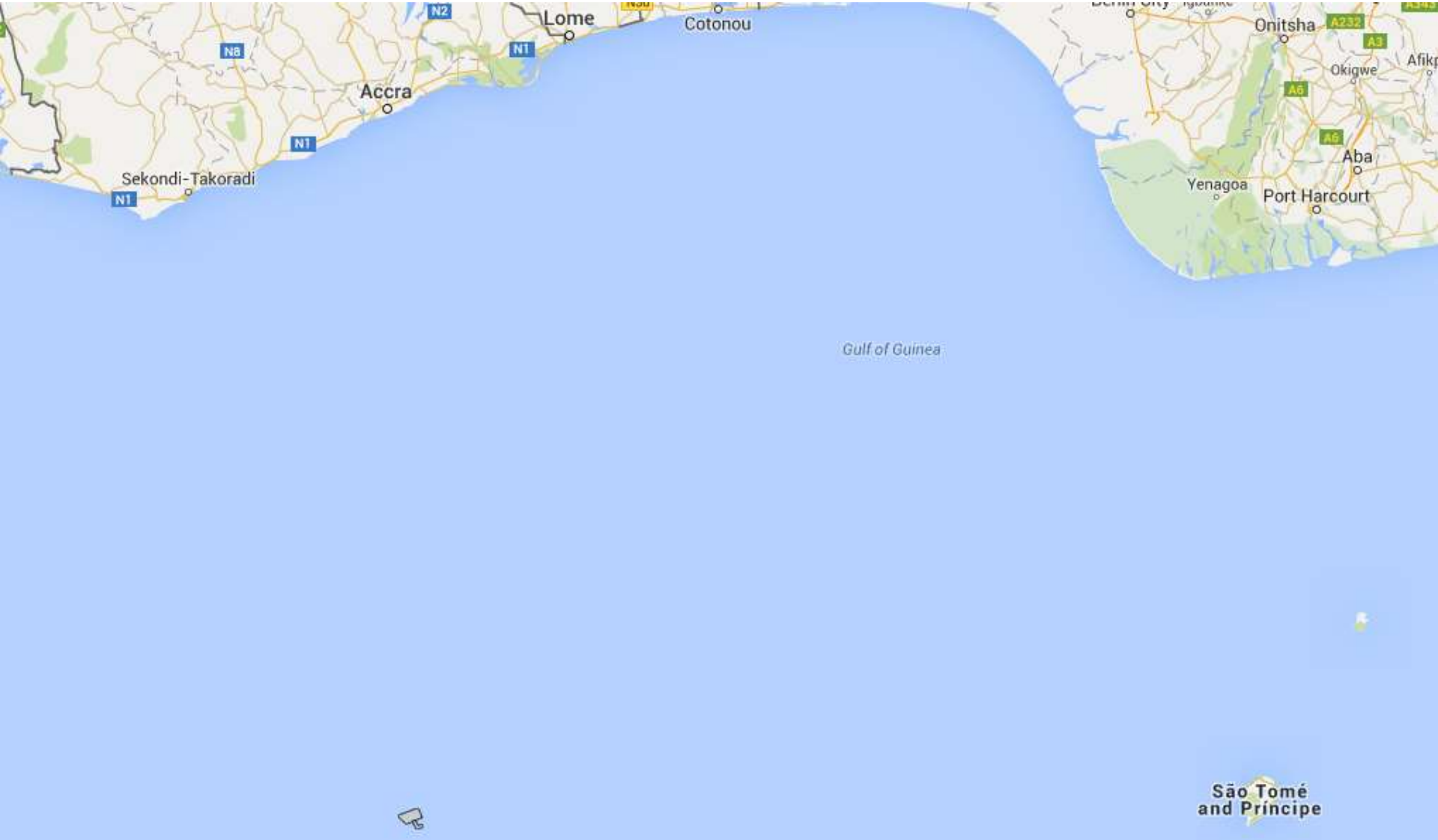
Sweeney Creek - 2

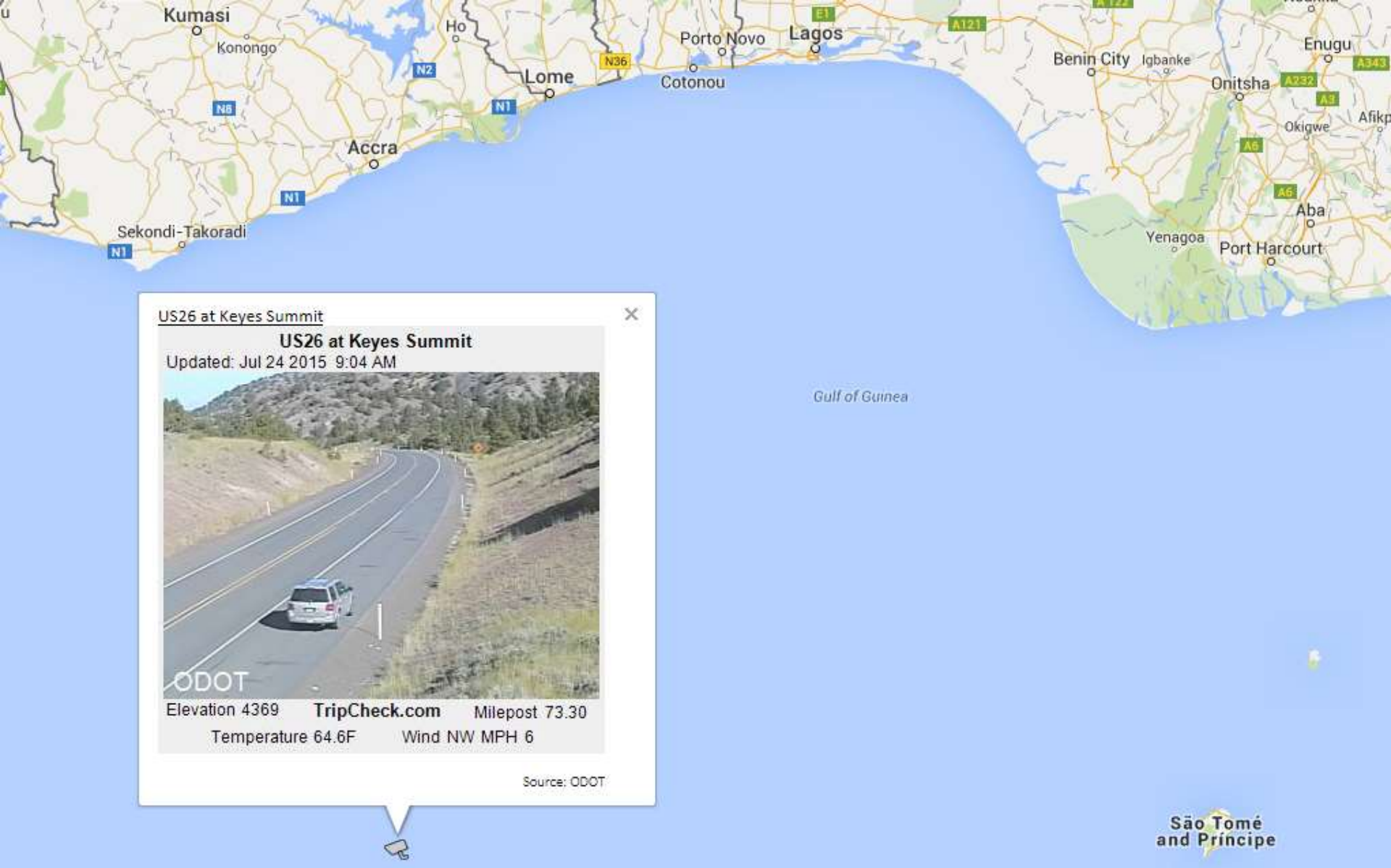
Source: CALTRANS

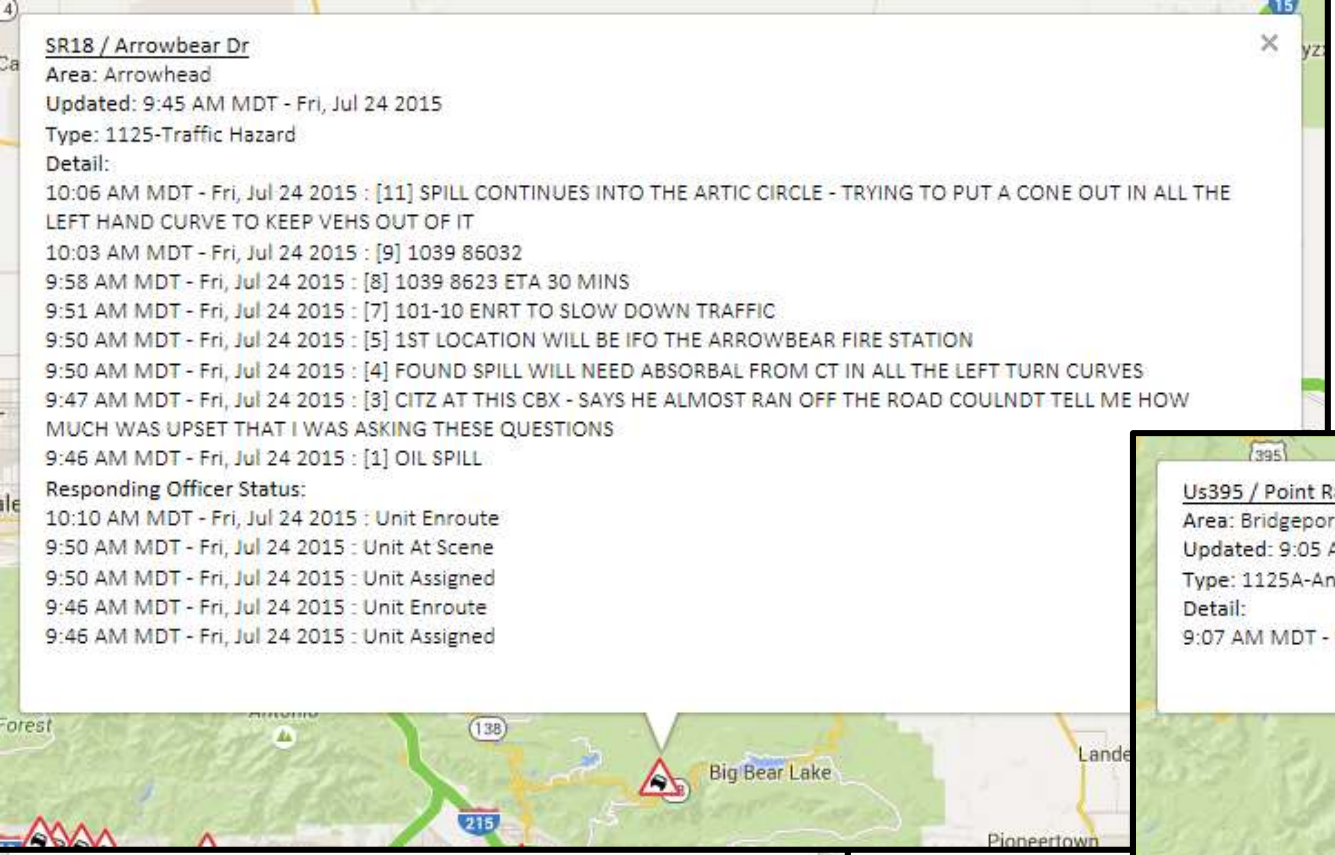
Source: Nevada Department of Transportation

Kingvale Eastbound

Source: CALTRANS

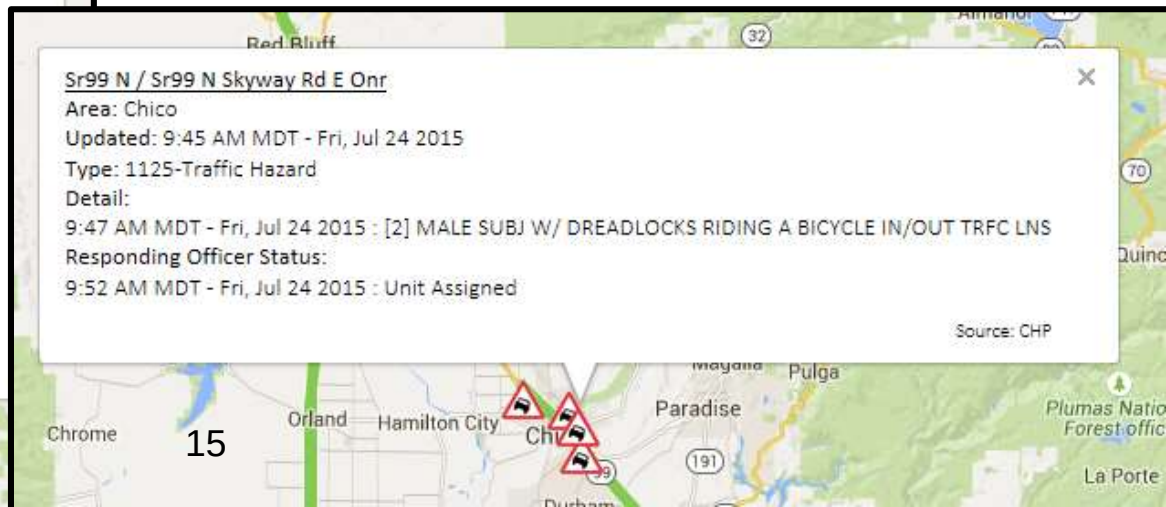

Lome
Cotonou
Onitsha
Okigwe
Accra
Sekondi-Takoradi
Aba
Yenagoa
Port Harcourt
Gulf of Guinea
São Tomé
and Príncipe

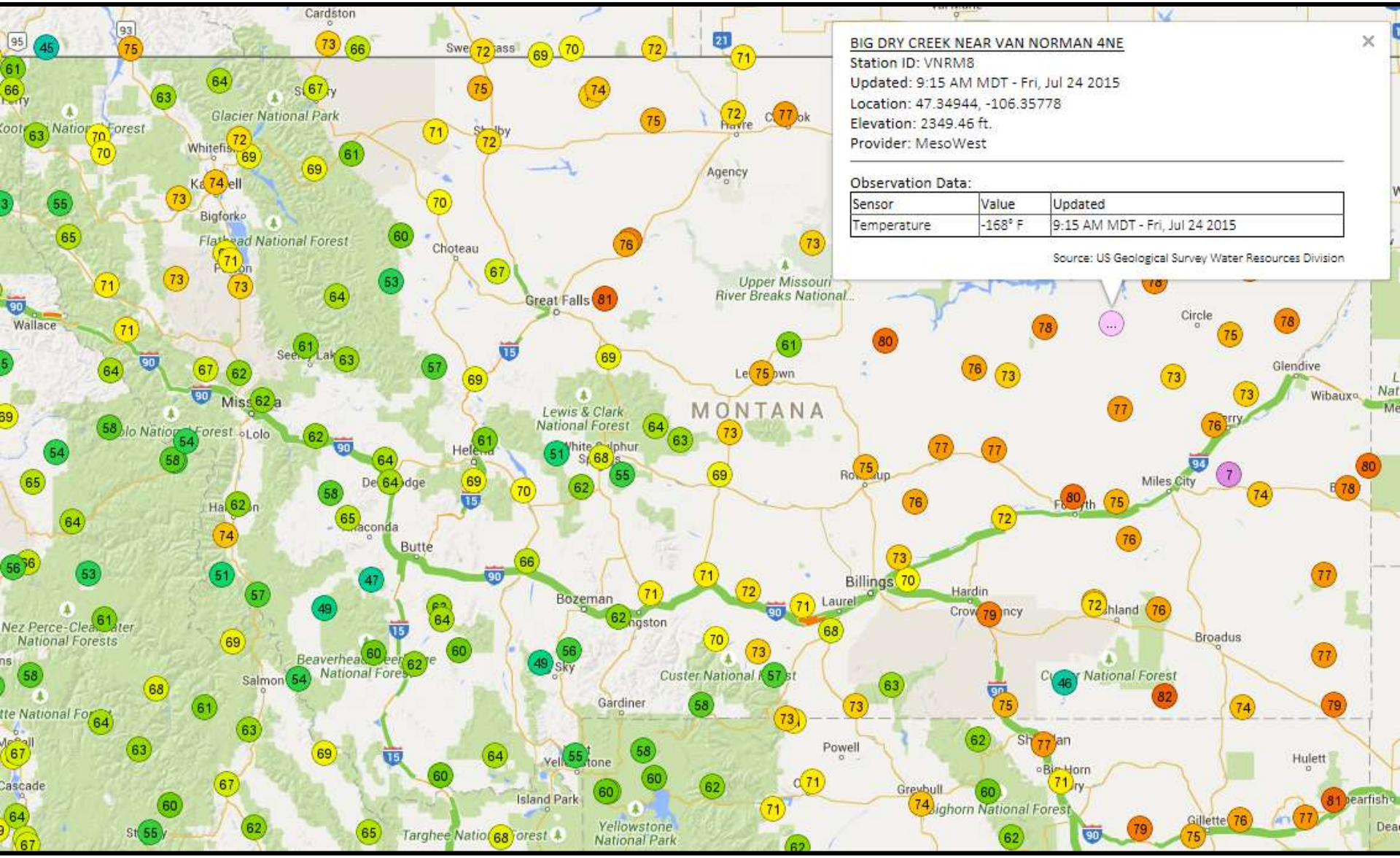

Kumasi
Konongo
Ho
Lome
Accra
Sekondi-Takoradi
Porto Novo
Cotonou
Lagos
Benin City
Igbanke
Onitsha
Enugu
Okigwe
Aba
Yenagoa
Port Harcourt
Gulf of Guinea
São Tomé and Príncipe
N1
N2
N6
N36
A121
A232
A3
A6
A343
US26 at Keyes Summit
US26 at Keyes Summit
Updated: Jul 24 2015 9:04 AM
ODOT
Elevation 4369
TripCheck.com
Milepost 73.30
Temperature 64.6F
Wind NW MPH 6
Source: ODOT

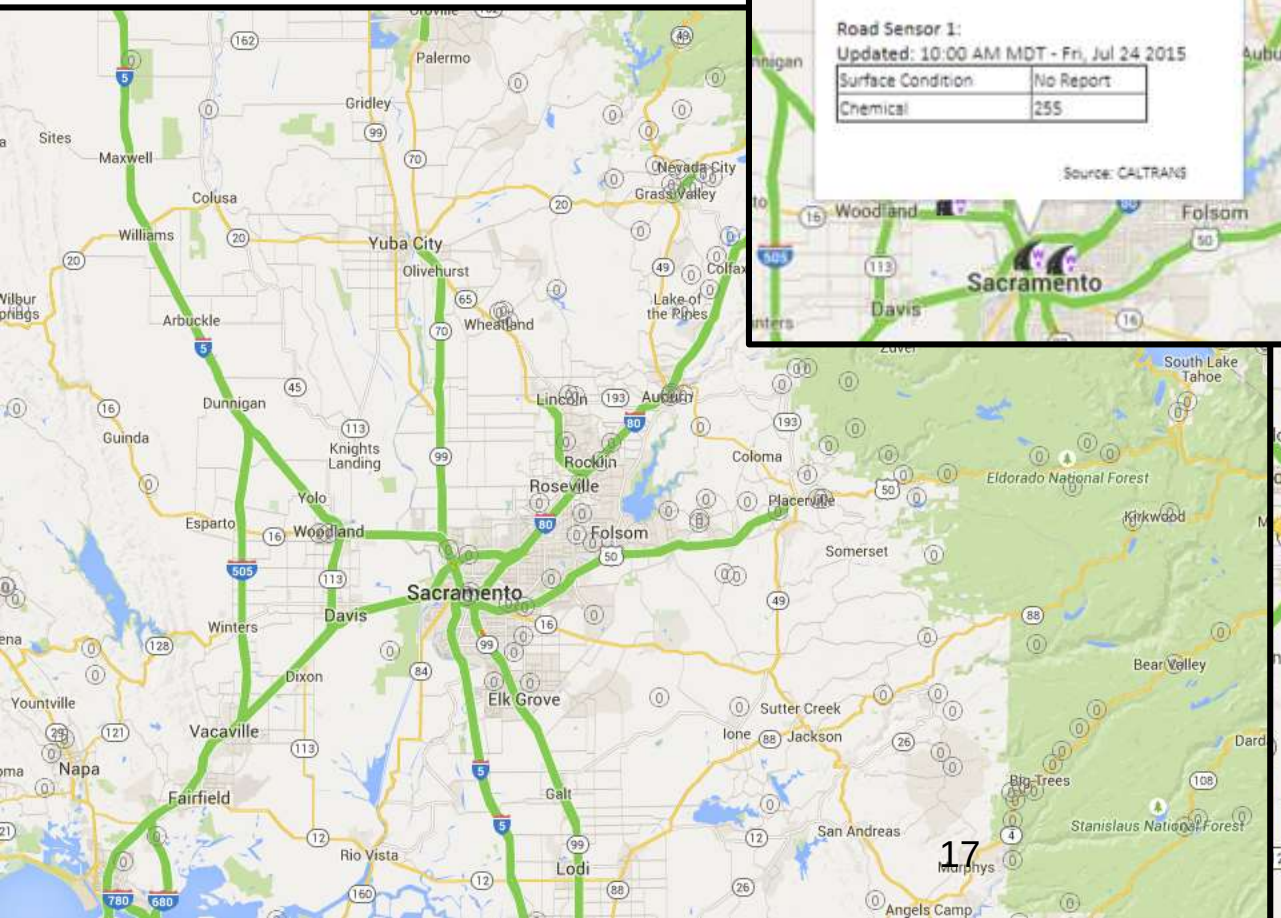

SR18 / Arrowbear Dr
Area: Arrowhead
Updated: 9:45 AM MDT - Fri, Jul 24 2015
Type: 1125-Traffic Hazard
Detail:
10:06 AM MDT - Fri, Jul 24 2015 : [11] SPILL CONTINUES INTO THE ARTIC CIRCLE - TRYING TO PUT A CONE OUT IN ALL THE LEFT HAND CURVE TO KEEP VEHS OUT OF IT
10:03 AM MDT - Fri, Jul 24 2015 : [9] 1039 86032
9:58 AM MDT - Fri, Jul 24 2015 : [8] 1039 8623 ETA 30 MINS
9:51 AM MDT - Fri, Jul 24 2015 : [7] 101-10 ENRT TO SLOW DOWN TRAFFIC
9:50 AM MDT - Fri, Jul 24 2015 : [5] 1ST LOCATION WILL BE IFO THE ARROWBEAR FIRE STATION
9:50 AM MDT - Fri, Jul 24 2015 : [4] FOUND SPILL WILL NEED ABSORBAL FROM CT IN ALL THE LEFT TURN CURVES
9:47 AM MDT - Fri, Jul 24 2015 : [3] CITZ AT THIS CBX - SAYS HE ALMOST RAN OFF THE ROAD COULNDT TELL ME HOW MUCH WAS UPSET THAT I WAS ASKING THESE QUESTIONS
9:46 AM MDT - Fri, Jul 24 2015 : [1] OIL SPILL
Responding Officer Status:
10:10 AM MDT - Fri, Jul 24 2015 : Unit Enroute
9:50 AM MDT - Fri, Jul 24 2015 : Unit At Scene
9:50 AM MDT - Fri, Jul 24 2015 : Unit Assigned
9:46 AM MDT - Fri, Jul 24 2015 : Unit Enroute
9:46 AM MDT - Fri, Jul 24 2015 : Unit Assigned
Big Bear Lake
138
215


Us395 / Point Ranch Rd
Area: Bridgeport
Updated: 9:05 AM MDT - Fri, Jul 24 2015
Type: 1125A-Animal Hazard
Detail:
9:07 AM MDT - Fri, Jul 24 2015 : [1] SHEEP ON RDWY
Source: CHP
Bridgeport
Willow Springs
Bodie
270


I5 S Jno A12
Area: Yreka
Updated: 9:38 AM MDT - Fri, Jul 24 2015
Type: 1125A-Animal Hazard
Detail:
9:39 AM MDT - Fri, Jul 24 2015 : [3] WIRY COAT, RUNNING AROUND IN CD
9:38 AM MDT - Fri, Jul 24 2015 : [1] DOG IN CD
Responding Officer Status:
9:46 AM MDT - Fri, Jul 24 2015 : Unit Cleared
9:45 AM MDT - Fri, Jul 24 2015 : Unit At Scene
9:45 AM MDT - Fri, Jul 24 2015 : Unit At Scene
9:41 AM MDT - Fri, Jul 24 2015 : Unit Enroute
9:41 AM MDT - Fri, Jul 24 2015 : Unit Assigned
9:40 AM MDT - Fri, Jul 24 2015 : Unit Assigned
Source: CHP
Yreka


Sr99 N / Sr99 N Skyway Rd E Onr
Area: Chico
Updated: 9:45 AM MDT - Fri, Jul 24 2015
Type: 1125-Traffic Hazard
Detail:
9:47 AM MDT - Fri, Jul 24 2015 : [2] MALE SUBJ W/ DREADLOCKS RIDING A BICYCLE IN/OUT TRFC LNS
Responding Officer Status:
9:52 AM MDT - Fri, Jul 24 2015 : Unit Assigned
Source: CHP
Red Bluff
Chrome
Orland
Hamilton City
Paradise
Pulga
32
70
191


BIG DRY CREEK NEAR VAN NORMAN 4NE
Station ID: VNRM8
Updated: 9:15 AM MDT - Fri, Jul 24 2015
Location: 47.34944, -106.35778
Elevation: 2349.46 ft.
Provider: MesoWest
Observation Data:
Sensor | Value | Updated
Temperature | -168° F | 9:15 AM MDT - Fri, Jul 24 2015
Source: US Geological Survey Water Resources Division
MONTANA
Great Falls
Billings
Bozeman
Butte
Missoula
Helena
Glacier National Park
Yellowstone National Park
Lewis & Clark National Forest
Flathead National Forest
Custer National Forest
Upper Missouri River Breaks National...
Beaverhead-Deerlodge National Forest
Nez Perce-Clearwater National Forests
Bighorn National Forest
Targhee National Forest
Cardston
Choteau
Agency
Circle
Glendive
Miles City
Broadus
Hardin
Laurel
Powell
Gardiner
Island Park
Cascade
Wallace
Bigfork
Lolo
Salmon
Anaconda
Whitefish
Wibaux
Hulett
Gillette



I-5 - Richards
Station ID: CA-509015
10:00 AM MDT - Fri, Jul 24 2015

Atmospheric Data:

Air Temperature	66.2° F
Wind Speed	4.97mph
Wind Gust	9.94mph
Wind Direction	188°
Max Wind Direction	301°
Dewpoint	55.04° F
Humidity	67.0%
Visibility	1.24mi

Road Sensor 0:
Updated: 10:00 AM MDT - Fri, Jul 24 2015

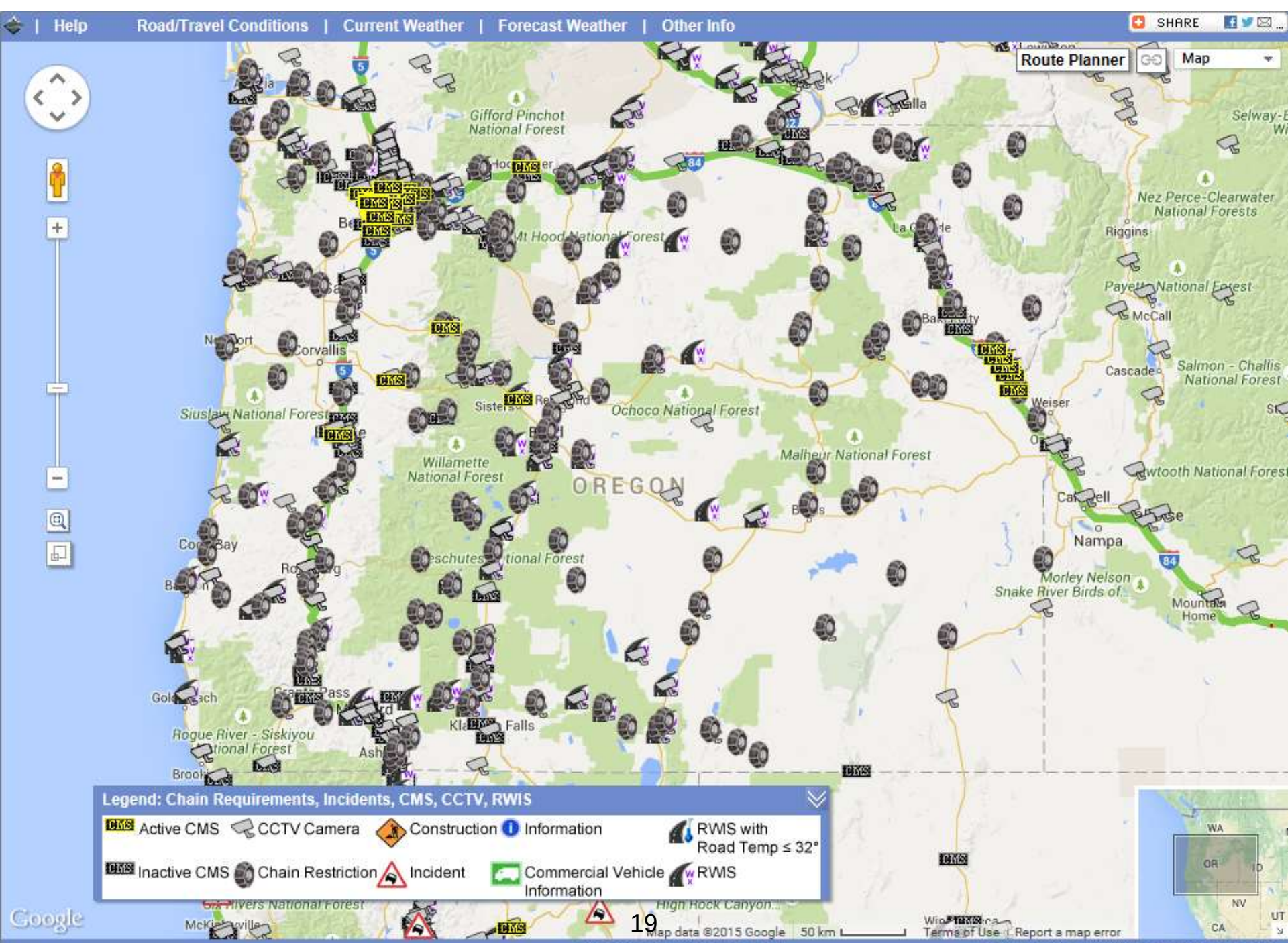
Surface Condition	Wet
Chemical	255

Road Sensor 1:
Updated: 10:00 AM MDT - Fri, Jul 24 2015

Surface Condition	No Report
Chemical	255

Source: CALTRANS


Low Probability of Light Rain Showers or Moderate Thunder Storm
Low Probability of Moderate Thunder Storm or Moderate Rain Showers
Low Probability of Heavy Rain Showers or Severe Thunder Storm
High Probability of Light Rain Showers or Moderate Thunder Storm
Low Probability of Severe Thunder Storm or Heavy Rain Showers
Low Probability of Moderate Thunder Storm or Light Snow Showers
Low Probability of Severe Thunder Storm
High Probability of Moderate Thunder Storm or Light Rain
High Probability of Severe Thunder Storm or Heavy Rain Showers
High Probability of Moderate Rain
Low Probability of Moderate Thunder Storm or Light Rain Showers
Low Probability of Moderate Thunder Storm or Light Rain Showers
NEVADA
Reno
Park City
Amarillo
Colville
Whitefish
Red Lodge
Gate
Clark
Outlook
Malta
Billings
Froid
Fairview
Alexander
89
212
18



Last Updated: 8/6/2015 10:39:04 AM MDT

Need

- There is erroneous data in existing feeds.
  - Many errors at an arbitrary time.
- We believe data quality has generally been handled on an ad hoc basis.
- We believe this is a systemic problem with many failure points.
- Caltrans and WSRTC are working on data quality relative to QuickMap and the One-Stop-Shop, among other projects such as WeatherShare. They feel it is a critically important issue that needs to be addressed.
- Other state DOTs anticipate benefit from this work.

Project Objective

The goal of this project is to analyze and document existing system best practices for data quality for the aggregation and dissemination of state department of transportation traveler information.

- Survey of DOT Practitioners
- Literature Search
- Document best practices (if found)

Survey of DOT Practitioners

Investigating the accuracy of data and metadata, what quality control measures are used, and how the data is handled throughout the process from collection to dissemination.

- How is the traveler information provided?
- What is done to make sure the information is right?
- How are errors/problems detected and fixed?

Survey

- Introductory email to identified contacts or general (traveler) information contact.
- Telephone interview or written responses.
- Contacted state DOTs in the Western States Region.
- Interviewed those responsible for traveler information for the state.

Interviewed:

- California
- Idaho
- Montana
- Nevada
- Oregon
- Utah
- Washington

Other Contacts:

- Arizona
- Colorado
- New Mexico
- Wyoming

Some General Responses

- *All those surveyed have been forthcoming in their responses and are very interested in the project. There was some agreement that the problem may be endemic.*
- *Many mentioned the Real-Time System Management Information Program (Section 1201 SAFETEA-LU, 23 CFR 511)*
- *Some mentioned data ownership.*
- *Some mentioned a need to clarify where the DOT should be in the traveler information environment.*

Some General Responses

- *There are varying levels and complexity of ITS deployments and associated traveler information around the region and within individual states.*
  - *Funding*
  - *Personnel*
  - *Need*
- *There is a lack of automation. (CA)*
- *There are no statewide defined procedures for data quality control and issue resolution. (CA)*

Survey

1. How do you find out about problems with your traveler information data or metadata? What do you do (as the individual responsible for traveler information) in regard to these things?
   a. Who finds out?
   b. Is it an automatic or manual process?
   c. Describe the process.
   d. If it is done manually, who does it and how often?
   e. How are problems resolved?
   f. How long does it take to resolve a problem?
   g. What issues have you had, if any, with data quality and traveler information? (Describe.)

Survey

Issues include:

- *CMS feeds (e.g., misspellings or typos, wrong abbreviations, multicultural challenges, sign limitations)*
- *Equipment failure or equipment end of life*
- *Cameras: offline, communications, power issues, potential old or partial picture, pixels out.*
- *Field element location*
- *Timeliness (e.g., old or stale information, miss a winter road report, wrong start date on construction project)*
- *Operator input error*
- *Sensors, sensor calibration*
- *Connectivity & Communications*
- *Missing information regarding an incident, construction, lane closures, etc.*

Survey

Find out about issues/problems via:

- *Public call in, email, social media*
- *Auto alerts, software*
- *Third party vendor*
- *Operations personnel*
- *511 phone line comment module*
- *Data owners*

Who finds out?

- *Depends on the problem. (RWIS, communications, software, etc.)*
- ***Traveler information person**, **state communications office***
- ***TMC**, **TOC***
- ***Operations personnel**, dispatch, district office*
- ***Third party vendor***
- ***ITS Maintenance**, **Regional ITS personnel***
- ***IT Maintenance***
- *In one state, **RWIS techs** monitor their own equipment.*

Survey

Process

- *Depends on the problem, and how/by who the problem is discovered.*
  - *Public calls in, problem directed to the appropriate person.*
  - *If camera down or image is stale, auto alert sent to phone.*
  - *Software indicates that data files are not up to date, email, text, phone call to TMC.*
  - *Third party vendor checking for readings outside thresholds, automatically generates service report. Notifications sent to the DOT contact.*
- *Elements and data feeds are checked more closely after system changes.*
- *When a data station or chain of data is lost, then it is filtered and flagged as "bad."*
- *In one case, the state patrol and maintenance are relied upon for reporting issues with VMS.*

Survey

Level of automation ranges from completely manual, to combination automatic and manual, to mostly automated.

- *Depends on resources (staff, funding) as well as type and complexity of systems.*
- *Desire for more automated quality control.*

Regarding manual quality control processes:

- *A) Human observations 7 days/week, a couple times per day. B) One time per day, one or two people look at each CCTV image. C) One staff following each week.*
- *Traveler information coordinator checks when a series of problems occur over a short period of time. CA: responsive mode.*
- *Read twice, post once. Those entering data manually are "self-policing and embarrassed if they make a mistake."*
- *Several states emphasized the importance of training for consistency and accuracy.*
- *Manual data entry process simplified as much as possible.*
- *Even manual entries have canned information that can be used.*
- *Spell checker functionality.*

Survey

Resolving problems

- *Depends on the problem.*
- *Operator interaction – fix or take out of service.*
- *Define the problem and then hand off to subject matter expert and/or a technician.*
- *Issue work order.*
- *Notify third party vendor.*
- *Maintenance contractors, regional ITS personnel, IT maintenance, technicians, etc.*
- *Close communications between maintenance and law enforcement during incidents.*

– *In California, urban areas/regions (MPOs) have their own internal processes so the DOT is not directly monitoring the data feeds.*

– *One state specifically mentioned system redundancy.*

– *One state indicated that "one user can start/stop everything; everyone knows what to do and can fix it themselves."*

– *One state said that they have no dedicated RWIS maintenance people. In rural areas, secondary road elements have a lower priority.*

Survey

How long does it take to resolve a problem?

- *Depends on the problem.*
- *"Most within two hours. Some that are more complicated take up to a week."*
- *"…, once detected, less than one minute (fast, seconds). 24-48 hours."*
- *"If it is just a reboot then it is fast. If a camera is broken, then it takes longer. Pretty quick. Takes priority."*
- *"Communications issues – relatively short time, less than one hour. If device failure, days to a week."*
- *"One minute to days or weeks."*
- *"Ten minutes to one week."*
- *"Data feed, fixed within 10 minutes. Quite often the public might not even know there was a problem. One to three days for other issues."*

Survey

2. What quality dimensions are used to characterize the traveler information system/site performance? Describe.
   a. E.g., accuracy, timeliness, reliability.
      i. Accuracy – is the data correct and how do you know it is correct?
      ii. Timeliness – is the data made available in a timely fashion and is the data current?
      iii. Reliability – percent up-time (the percentage of time the data meeting criteria i and ii is available for use).

Quality Dimensions

Survey

- *Most states mentioned the Real-Time System Management Information Program (Section 1201 SAFETEA-LU, 23 CFR 511) and the challenges associated with meeting its reporting requirements.*
  - *Includes minimum requirements.*
  - *There are no specific metrics or definitions for data quality for RWIS or CMS.*
  - *As one state said, "This has been problematic - how to measure accuracy of … incident data…"we're reporting what we know but how do we know if that's all.""*
  - *The requirement can be met, but* ***if the quality of the information can't be quantified or defined, you can meet the requirement with garbage data****.*
- *One state indicated that characterizing system/site performance was an "operations thing" and that there was no formal process.*
- *Another state said they collect public feedback and do a public survey every two years.*
- *"If it isn't measured, then it isn't fixed."*
- *California indicated a need for a data governance model and a common statewide standard.*

Quality Dimensions

Survey

Accuracy

- *Visual confirmation.*
- *Check portable license plate readers/travel times one to three times per year.*
- *No way of tracking through 511.*
- *District centric.*

Timeliness

- ***Update times based on federal requirements.***
- *Many data feeds updated every 15 minutes.*
- *"Very good."*
- *Valid image every 20 minutes.*
- *CMS update every 5 minutes or are blank depending on time of day. Do not keep track as there are too many elements to monitor. Do check situationally.*
- ***"We are very short on metrics for traveler information performance measures. We do not have any metrics on the time it takes to disseminate information. This would be a great improvement in our department."***
- *"Supposed to be 85% up."*

Quality Dimensions

- *Reliability*
  - *"Recently, traveler information system is "exceedingly reliable" and near 100%. Data entry is 98% reliable. Downtime is usually for scheduled maintenance, server or system upgrades."*
  - *"We have some metrics for this through an asset management program. The reliability metrics are mostly hardware related and not message related."*
  - *One region (in one state) indicated upper 90's for reliability.*
  - *One state compiles a database of outages with the number of devices and uses it to extrapolate percent up and down time.*
  - *CFR minimums and general guidelines. This metric is required for federal funding requests.*
  - *A need to automate and define metrics.*
  - *75% statewide considered "good", but terrible to traveler information staff.*
  - *"Want to do timestamps."*
  - *Copper theft an issue.*
  - *Funding an issue.*

Survey

3. What other quality control processes are in place to ensure proper operation of field elements AND provision/dissemination of their associated data?
   a. E.g., verification of CMS messages with a CCTV camera; ground truthing and sensor calibration; user reporting of errors; etc.
   b. Status messages (i.e., camera down for maintenance, flag weather sensor readings to indicate if they are questionable or bad.)

Other Quality Control Processes

- *Operator observations and human interactions*
- *Review TMC logs*
- *Go through an extensive checklist at TMC shift change which includes a review of what is up and what is down.*
- *Check CMS messages:*
  - *CCTV camera*
  - *Public facing traffic website*
  - *Communications channel within the sign software*
- *One state indicated that they had "resisted" the concept of verifying CMS messages with a CCTV camera because the "software was better than that." Instead, it is done remotely and logs checked for compliance.*
- *For another state, the "… software for displaying an error message for a broken camera does not trigger a work order or any other type of notification to the developers. We are working to fix this oversight. Also, no notification comes in when servers need to be reset to continue disseminating traveler information, which leaves finding errors to chance. This is an area that needs improvement."*
- *"User reporting is ad-hoc."*

Survey

Other Quality Control Processes

- ***Post status messages (i.e., "Camera unavailable" or "Camera down for maintenance")***
- *Two people in each TMC always looking at all of the ITS field elements.*
- *A contractor is tracking how often field elements are not available.*
- *Multiple images available at each RWIS site.*
- ***In one state, four times per month all data entry is tracked. A sample is taken and errors noted. Error frequency is about 2% - 98% or better accuracy.*** *Similarly, each TOC in another state has their own quality assurance processes which includes a monthly sample of incidents with a review of response relative to accuracy and procedure.*
- ***Contractor does remote calibration when needed.***
- ***Rigorous testing of field elements as they are brought online before going live.***
- ***Preventive maintenance on all RWIS systems.***
- *Work with maintenance to look at something specific while in the field (i.e., frozen camera, bad bulbs, etc.). Very manual process.*
- *One state said they had no ITS solutions for processes such as CMS message verification, although section staff might verify a sign message.*

Survey

4. Generally and briefly, how is DOT data used for traveler information handled from collection to dissemination? How does data get from the field to the public view (online, 511, TV/radio, social media)?

Survey

Traveler Information Data from Collection to Dissemination

- **California:** *Data from field elements is aggregated in the district TMC (could be multiple systems) by respective ITS unit. The information is shared by publishing to the Commercial Wholesale Web Portal 2 (CWWP2). DOT traveler information office pulls the data from the portal and repackages it for the web page and the IVR phone system. The data is the same for Caltrans and the public.*
- **Idaho:** *Multiple sources of information, both auto feeds and manual entry, are all fed to a third party vendor which creates events. Outputs include 511 phone system, websites (mobile version, customizable high bandwidth version, low bandwidth version for commercial vehicle operators), link to transit operators, social media (Twitter), and a smart phone app. The data can be pushed to the public or the public can passively receive it.*
- **Montana:** *Drivers radio road conditions to division offices. Division/district staff enter the information into a database which disseminates it to various outlets (511, web, mobile, social media).*
- **Nevada:** *Central System Software collects information from ITS devices and populates the 511 system as well as public device interfaces. Data is published to an FTP site. With the newly created Nevada Data Exchange, devices are polled by the transportation management system, sent to the NDEX, and then distributed everywhere else.*

Survey

Traveler Information Data from Collection to Dissemination

- **Oregon:** *The system is highly automated and integrated, very little is done manually. Once the information is in the system, it goes everywhere (TripCheck, 511, TV). Those entries that are done manually are reviewed by a TOC operator before it goes out. When the TOC operator enters something, the TOC software builds the message for them and it can be edited or left as is.*
- **Utah:** *"UDOT's traveler information outlets include Twitter, Facebook, 511 phone line, CMS, a website, a mobile website and a smartphone app. We also share camera feeds with local media. UDOT has a fiber optic network of over 1800 miles which helps get communication/messaging to rural devices."*
- **Washington:** *In the Northwest Region, data is collected from the field and sent to the central server with central software which has multiple pulling and polling functions. The data is repackaged and published to a web accessible database that can be queried. The data is then pushed out to the various outlets. In the South Central region which is more rural, data from the mountain passes is manually collected and keyed in by operations personnel. It is then pushed to the public (i.e., 511 system) via the same database. RWIS/weather data are not on social media. The Twitter feed is automated for the Olympic and Southwest Regions*

Survey

5. Does the DOT have a data repository that allows public and/or third-party access to the raw data? How is the data accessible and how is it documented?

- *Several states have some sort of publically accessible data repository.*
- *E.g., California's Commercial Wholesale Web Portal 2 (CWWP2)*

Survey

6. Any other relevant information you would like to share?

- *“Trying to improve.”*
- *Many indicated future additions and improvements to their traveler information data and systems.*

Survey

7. Is there anyone else that I should talk with, either within (state) or in other states?

- *Some additional contacts were identified.*

8. Would you like a copy of the project's findings?

- ***All confirmed interest in the results of this project.***

Literature Search

- Bounded by limiting the search to information on data quality within the transportation field.
- Real-Time System Management Information Program (1201)
  - "…establishes a **real-time system management information program** pursuant to Section 1201 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)."
  - "The Real-Time System Management Information Program is to provide the capability to monitor in real-time the traffic and travel conditions of the major highways across the U.S. and provide a means of sharing these data with state and local governments and with the traveling public."
  - Established minimum requirements for real-time traffic and road condition information (construction activities, road or lane blocking incidents, road weather observations, travel times; information accuracy; information availability).
  - **Methods for measuring accuracy or other quality metrics are not included.** (E.g., how do you know the requirement is being met with "good" data versus "garbage" data?)
  - Does not define metrics for specific elements such as RWIS or CMS.

Real-Time System Management Information Program [1201] Section 511.309

- Minimum requirements for traffic and travel conditions made available by real-time information programs are:
  - Construction activities. The timeliness for the availability of information about full construction activities that close or reopen roadways or lanes will be 20 minutes or less from the time of the closure for highways outside of Metropolitan Areas and 10 minutes or less from the time of the closure or reopening for roadways within Metropolitan areas. Short-term or intermittent lane closures of limited duration that are less than the required reporting times are not included as a minimum requirement under this section.
  - Roadway or lane blocking incidents. The timeliness for the availability of information related to roadway or lane blocking traffic incident will be 20 minutes or less from the time that the incident is verified for highways outside of Metropolitan Areas and 10 minutes or less from the time that the incident is verified for roadways within Metropolitan areas.
  - Roadway weather observations. The timeliness for the availability of information about hazardous driving conditions and roadway or lane closures or blockages because of adverse weather conditions will be 20 minutes or less from the time the hazardous conditions, blockage, or closure is observed.
  - Travel time information. The timeliness for the availability of travel time information along limited access roadway segments within Metropolitan Areas will be 10 minutes or less from the time that the travel time calculation is completed.
  - **Information accuracy. The designed accuracy for a real-time information program shall be 85 percent accurate at a minimum, or have a maximum error rate of 15 percent.**
  - Information availability. The designed availability for a real-time information program shall be 90 percent available at a minimum.

Source: http://ops.fhwa.dot.gov/1201/factsheet/

Literature Search

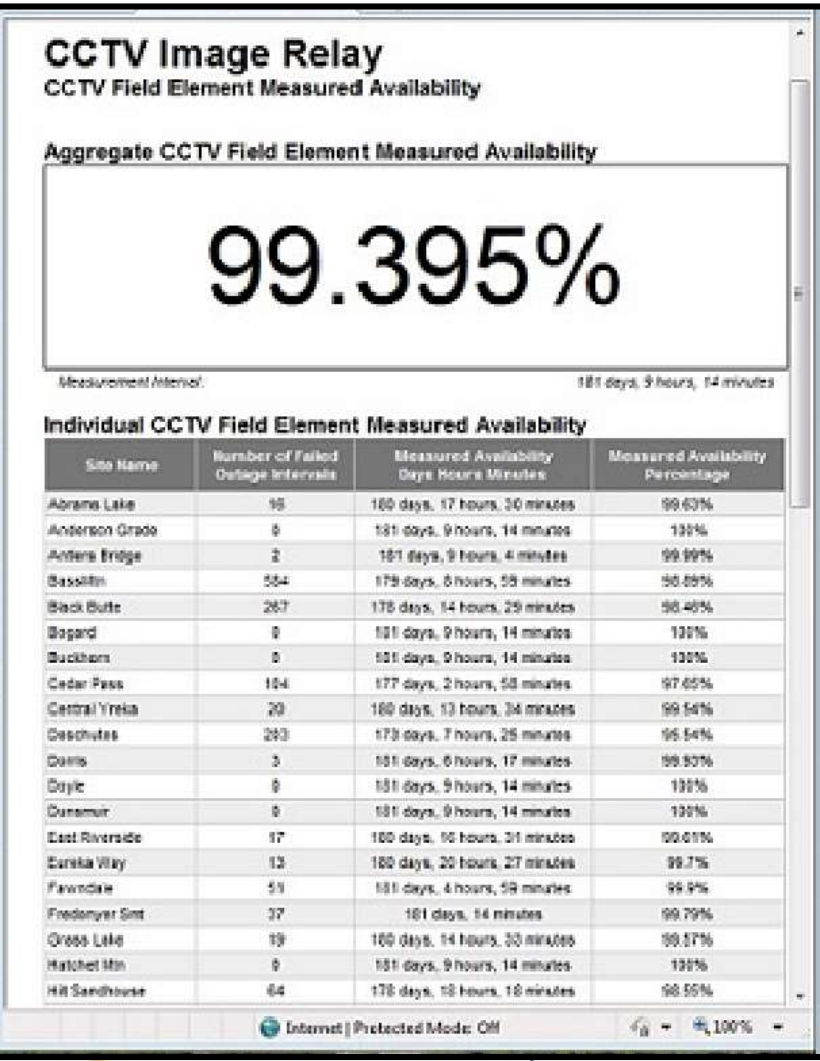
- Studies involving data quality for specific elements or types of traveler information (e.g., CMS, travel times, RWIS, CCTV, etc.)
- Older studies from FHWA that define aspects of data quality and how to measure them.
- *Clarus* Quality Checking Algorithm Documentation Report

Next Steps

- Conduct interviews with remaining state DOTs.
- Continue literature search as appropriate.

What We're Doing …

Caltrans District 2 Information Relay



CCTV Image Relay

CCTV Field Element Measured Availability

Aggregate CCTV Field Element Measured Availability

99.395%

Measurement Interval: 181 days, 9 hours, 14 minutes

Individual CCTV Field Element Measured Availability

Site Name	Number of Failed Outage Intervals	Measured Availability Days Hours Minutes	Measured Availability Percentage
Abrams Lake	16	180 days, 17 hours, 30 minutes	99.63%
Anderson Grade	0	181 days, 9 hours, 14 minutes	100%
Antlers Bridge	2	181 days, 9 hours, 4 minutes	99.99%
Bassillin	584	179 days, 6 hours, 59 minutes	98.89%
Black Butte	267	176 days, 14 hours, 29 minutes	98.46%
Bogard	0	181 days, 9 hours, 14 minutes	100%
Buckhorn	0	181 days, 9 hours, 14 minutes	100%
Cedar Pass	104	177 days, 2 hours, 58 minutes	97.65%
Central Yreka	20	180 days, 13 hours, 34 minutes	99.54%
Deschutes	203	173 days, 7 hours, 25 minutes	95.54%
Dorris	3	181 days, 6 hours, 17 minutes	99.93%
Doyle	0	181 days, 9 hours, 14 minutes	100%
Dunsmuir	0	181 days, 9 hours, 14 minutes	100%
East Riverside	17	180 days, 16 hours, 31 minutes	99.61%
Eureka Way	13	180 days, 20 hours, 27 minutes	99.7%
Fawndale	51	181 days, 4 hours, 59 minutes	99.9%
Fredonyer Smt	27	181 days, 14 minutes	99.79%
Grass Lake	19	180 days, 14 hours, 30 minutes	99.57%
Hatchet Mtn	0	181 days, 9 hours, 14 minutes	100%
Hill Sandhouse	64	178 days, 18 hours, 18 minutes	98.55%

Internet | Protected Mode: Off 100%

District 2 RWIS Information Relay

Field Element Measured Availability

Aggregate RWIS Field Element Measured Availability

99.568%

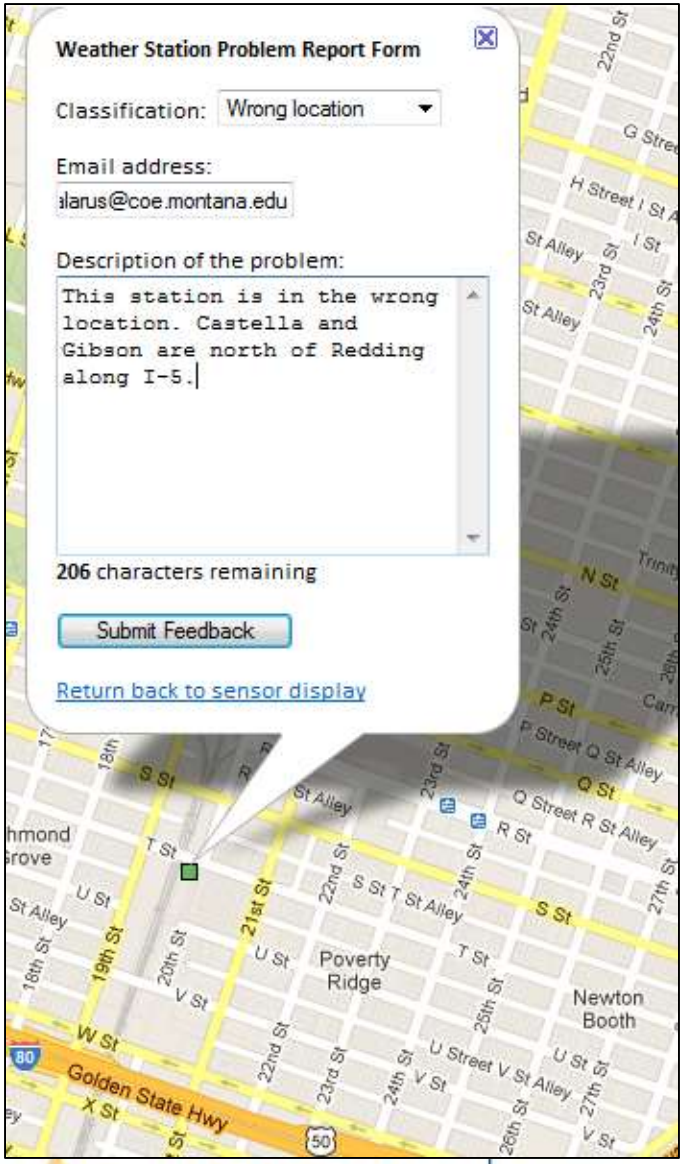
Aggregate Measurement Interval: 62 days 19 hours 16 minutes
September 10, 2013 to November 12, 2013

Individual RWIS Field Element Measured Availability

Site Name	Down for Construction Days Hours Minutes	Measured Availability Days Hours Minutes	Total Time Days Hours Minutes	Measured Availability Percentage
Andersen Grade	15 minutes	62 days 18 hours	62 days 18 hours 15 minutes	100.00%
AntlersSmtRWIS	15 minutes	62 days 16 hours 45 minutes	62 days 17 hours 30 minutes	99.97%
Black Butte	32 days 17 hours 45 minutes	29 days 3 hours	62 days 17 hours 30 minutes	97.12%
Bogard	-	62 days 18 hours	62 days 18 hours	100.00%
Buckhorn	15 minutes	62 days 17 hours	62 days 17 hours 30 minutes	99.96%
Doyle	-	62 days 17 hours 15 minutes	62 days 17 hours 45 minutes	99.97%
Dunsmuir	-	62 days 17 hours	62 days 17 hours 30 minutes	99.97%
Fredonyer Smt	-	62 days 18 hours	62 days 18 hours	100.00%
FredonyerEastRWIS	-	62 days 15 hours 45 minutes	62 days 17 hours 45 minutes	99.87%
Hatchet Mtn	-	62 days 17 hours 30 minutes	62 days 18 hours	99.97%
HillRWIS	-	62 days 18 hours 15 minutes	62 days 18 hours 30 minutes	99.96%
HornbrookRWIS	-	62 days 18 hours 15 minutes	62 days 18 hours 15 minutes	100.00%
Janesville	-	62 days 18 hours	62 days 18 hours	100.00%
NorthWestRWIS	28 days 45 minutes	-	28 days 45 minutes	-
Oregon Mtn	-	62 days 15 hours 45 minutes	62 days 17 hours 15 minutes	99.90%
SnowmanRWIS	-	62 days 18 hours 45 minutes	62 days 17 hours	99.58%
Spring Garden	-	60 days 14 hours 30 minutes	62 days 18 hours	96.58%
Volmers	26 days 19 hours	5 days 1 hours	31 days 21 hours	100.00%
Weed Airport	-	61 days 18 hours 30 minutes	62 days 17 hours 45 minutes	98.46%

Internet | Protected Mode: Off 100%

WeatherShare “Report a Problem”



User Feedback

Unresolved reports | | Resolved reports | | All reports | | Logout

17 report(s), displaying 1 - 17

Mark as Resolved | | Mark as Unresolved | | Delete |< < > >|

Rep. No	Date	Type	Station Name, ID	Message
182	2013-01-29 15:36:54	0	GIBSON NEAR CASTELLA 10SSW, 2107 enable	This station is in the wrong location. C...
181	2013-01-29 12:25:50	0	CW0234 Canyon Country, 1415 enable	
180	2013-01-08 22:38:12	1	I-40 Barstow, 29 disable	wrong temp data. off 40 deg f.
179	2013-01-08 22:37:29	1	I-40 Barstow, 29 disable	wrong temp data. off 40 deg f
178	2012-12-19 12:01:21	1	GIBSON NEAR CASTELLA 10SSW, 2107 enable	This station is registering sub-freezing...
177	2012-11-28 14:45:01	0	GIBSON NEAR CASTELLA 10SSW, 2107 enable	This looks like it may be in the wrong l...
176	2012-07-05 09:58:02	2	Oregon Mountain Summit, 30 disable	I am looking for local barometric data t...
175	2012-04-12 17:42:27	2	Snowmans Summit, 42 disable	downloading CSV data for Snowman Hill al...
174	2011-12-05 14:52:14	2	SOUTH LAKE TAHOE, 3604 disable	The elevation description of station 38 ...
173	2011-07-21 14:59:55	0	North Cushing Creek, 48 disable	I believe this station is shown in the w...
172	2011-03-18 16:35:36	1	RED BLUFF MUNICI, 3637 disable	it list a negative amount of precipitation -0.004
171	2011-02-25 11:08:04	1	NAPA CORPORATION YARD, 1106 disable	temperature seems unusually low compared...
170	2011-02-17 14:50:18	2	MOUNT SHASTA, 3653 disable	The Elevation is wrong. I think there i...
169	2010-12-19 14:17:17	1	CW8514 Ventura, 3717 disable	Rain data for 1Hr
168	2010-12-13 09:08:56	0	GIBSON NEAR CASTELLA 10SSW, 2107 enable	Wrong location.
167	2010-04-19 16:52:37	1	WEED AIRPORT, 809 disable	Wind Direction is opposite of reality an...
166	2010-04-06 16:43:37	1	Richards, 80 disable	it says 212F ....I can't believe that's true!

Mark as Resolved | | Mark as Unresolved | | Delete |< < > >|

WeatherShare RWIS Station Quality Control Report

RWIS Station Report

Show All Stations

14 sensor(s), displaying 1 - 14

QC 1: QC 2: QC 3:

|< < > >|

ID	Name	Lat	Lon	Elevation	District	County	Last Updated (UTC)	Sensor Name	Sensor Code	Sensor Value	QC Detail
303002	I-15 Windy Point	34.26099	-117.43651	3381	8	San Bernardino	2012-11-24 16:30:34	Temperature	AirTemp	64	Link
303000	I-15 Duncan Rd	34.17951	-117.45789	2486	8	San Bernardino	2011-05-25 08:15:01	Temperature	AirTemp	54	Link
259006	I-10 Jefferson St.	33.75746	-116.28414	73	8	Riverside	2011-12-19 21:16:30	Temperature	AirTemp	112	Link
164004	Rt 58 Broome Rd	35.24044	-118.59432	2639	6	Kern	0000-00-00 00:00:00	Temperature	AirTemp	80	Link
164005	RT 58 Tehachapi Summit	35.18326	-118.43855	4996	6	Kern	0000-00-00 00:00:00	Temperature	AirTemp	89	Link
509005	Brockway Summit	39.25514	-120.05591	6718	3	Placer	2012-06-18 22:46:07	Temperature	AirTemp	69	Link
I-80BryteBend	I-80 Bryte Bend	38.60300	-121.54481	18	3	Sacramento	2007-04-10 21:21:38	Temperature	essAirTemperature.1	74	Link
509013	Exposition Blvd.- Sac - 51N @ Tribute	38.59163	-121.44535	26	3	Sacramento	2013-05-23 21:10:34	Temperature	AirTemp	32	Link
509008	I-80 Donner Pass-Weigh Stn	39.36222	-120.13010	5828	3	Nevada	2013-05-23 21:18:06	Temperature	AirTemp	32	Link
Richards	Richards	38.59847	-121.50440	49	3	Sacramento	2007-04-25 12:47:30	Temperature	essAirTemperature.1	212	Link
Floriston	Floriston	39.39559	-120.02387	5301	3	Nevada	2007-11-11 01:39:02	Temperature	essAirTemperature.1	212	Link
537002	North Weed Cut	41.42952	-122.40325	3454	2	Siskiyou	2012-05-14 20:03:59	Temperature	AirTemp	75	Link
547001	South Cushing Creek	41.70306	-124.12365	1045	1	Del Norte	2012-12-27 21:58:59	Dew Point	Dewpoint	98	Link
547001	South Cushing Creek	41.70306	-124.12365	1045	1	Del Norte	2012-12-27 21:58:59	Temperature	AirTemp	103	Link

|< < > >|

Download CSV
Logout

WeatherShare Quality Control Detail

Quality Control Detail

Exposition Blvd.- Sac - 51N @ Tribute : Temperature Sensor : **32 °F**

Latitude: 38.59163 **Longitude:** -121.44535 **Elevation:** 26
Source: CALTRANS **Last Update (UTC):** 2013-05-23 21:30:46 **Map Display:** Link

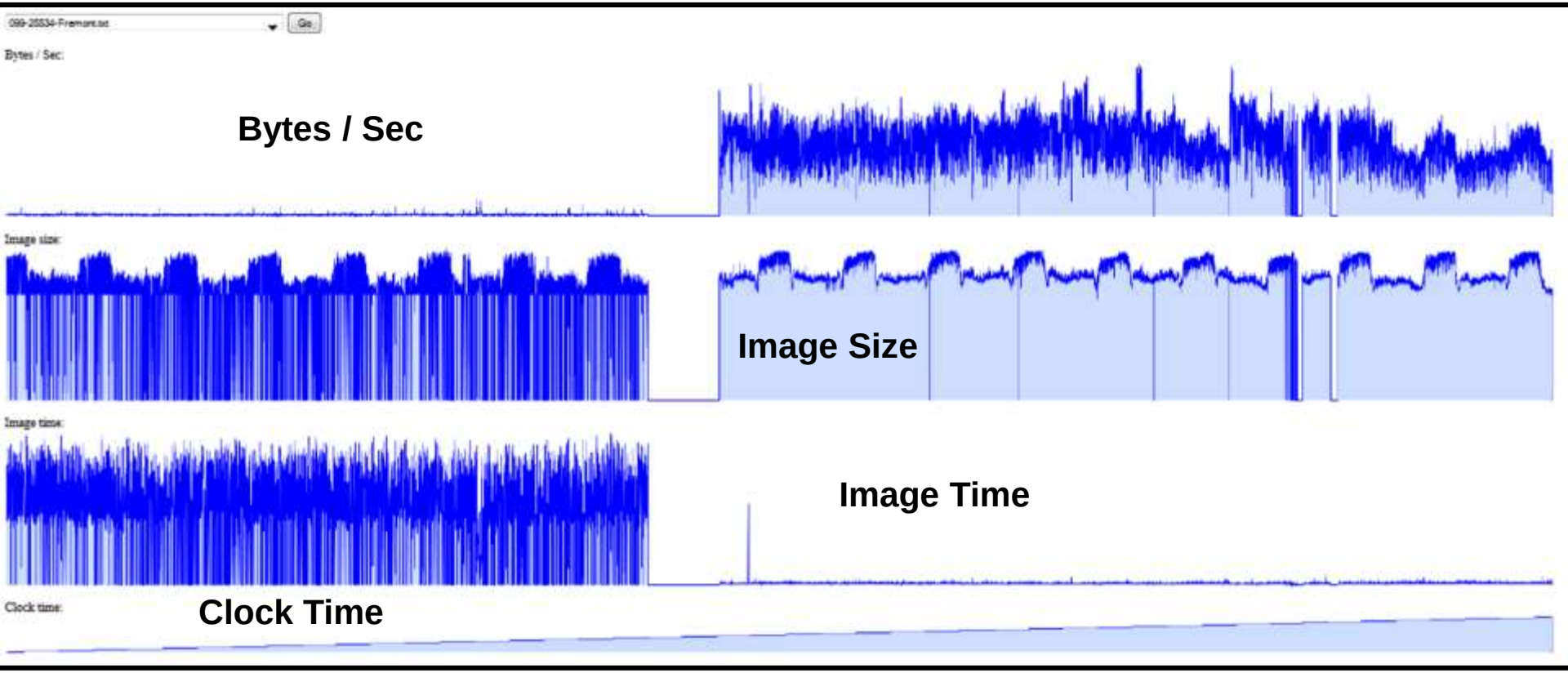
QC Summary

QC Level	Description	Valid At	Pass/Fail
1	Range Check	-60 : 130 °F	Pass
2	Temporal Consistency	> 20°F/hour or no change in 24 hours	Fail
3	Spatial Consistency	|(Predicted value - Actual value)| < 10	N/A

Past Sensor Readings (6hr)

Timestamp (UTC)	Reading	Raw Data	QC
2013-05-23 21:30:46	32	0	Failed - 2
2013-05-23 21:10:34	32	0	Failed - 2
2013-05-23 21:00:38	32	0	Failed - 2
2013-05-23 20:40:50	32	0	Failed - 2
2013-05-23 20:30:37	32	0	Failed - 2
2013-05-23 20:10:27	32	0	Failed - 2
2013-05-23 20:00:50	32	0	Failed - 2
2013-05-23 19:40:37	32	0	Failed - 2
2013-05-23 19:30:45	32	0	Failed - 2
2013-05-23 19:10:40	32	0	Failed - 2
2013-05-23 19:00:35	32	0	Failed - 2
2013-05-23 18:40:26	32	0	Failed - 2
2013-05-23 18:30:35	32	0	Failed - 2
2013-05-23 18:10:25	32	0	Failed - 2
2013-05-23 18:01:09	32	0	Failed - 2
2013-05-23 17:41:01	32	0	Failed - 2
2013-05-23 17:30:43	32	0	Failed - 2
2013-05-23 17:10:58	32	0	Failed - 2
2013-05-23 17:00:46	32	0	Failed - 2
2013-05-23 16:40:32	32	0	Failed - 2
2013-05-23 16:30:36	32	0	Failed - 2
2013-05-23 16:10:33	32	0	Failed - 2
2013-05-23 16:00:50	32	0	Failed - 2
2013-05-23 15:40:40	32	0	Failed - 2
2013-05-23 15:31:03	32	0	Failed - 2

Caltrans CWWP2
Image Retrieval Statistics



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Western States Rural Transportation Consortium

For Further Information See:

http://oss.weathershare.org

http://www.westernstates.org

http://www.westernstates.org/Projects/Default.html