

# Iowa DOT's Mobile Truck Cameras and GPS Experience

Columbus, Ohio

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Iowa DOT



# Iowa DOT's Mobile Truck Cameras and GPS Experience

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# Agenda

- Iowa DOT Overview
- The Plow Data Story
  - Initial GPS/AVL Development
  - Dash Cameras
  - Involving the Public
  - Future direction
  - Lessons learned

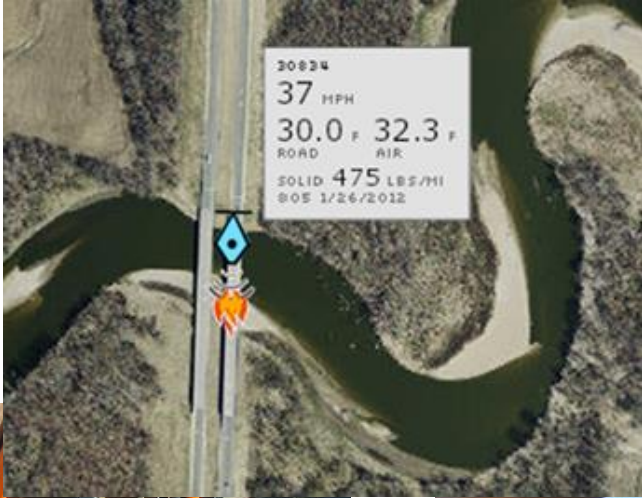


- Primary Roadway Responsibilities:
  - 24,122 lane miles of roadway
  - 3,687 lane miles of Interstate (ramps included)
  - 9,403 centerline miles of roadway
  - 3 different winter service levels
- Equipment
  - 892 Snowplows
  - 53 Motor graders
  - 133 Endloaders
  - 12 Heavy duty self-propelled snow blowers
  - 76 Snow blower attachments for loaders/tractors
  - 12 Tow Plows



- Budget
  - \$43 Million snow/ice budget
  - 5 year Avg Salt usage – 166,539 tons
  - Avg price per ton (2015 Contract) = \$75.01
  - ~17.8 Million gallons brine/year
- 109 Maintenance facilities
- Staffing
  - 1,051 Permanent staff
  - 462 Seasonal staff
  - 5-year average winter hours = 409,090 hours

# Our AVL/Plowcam Experience




# Goals and Objectives:

- Purpose was to understand & visualize
  - Fleet Movement
  - Material Usage
- Provide
  - Tools for managers to direct fleet
  - Less paperwork for drivers
  - Public a better winter driving experience
- Turn plow data into information we could use to become more efficient
- Access to raw data for custom reporting
- Selected LTI as a vendor (<https://www.loctech.com/>)

# Full Deployment -- 2012/13

- Used the simpler modem (LT6 unit)
- Made the system invisible to the driver
- Standardized spreader controllers
- Install on all ~900 plows
- More robust database architecture
- Began integration with existing resource management systems

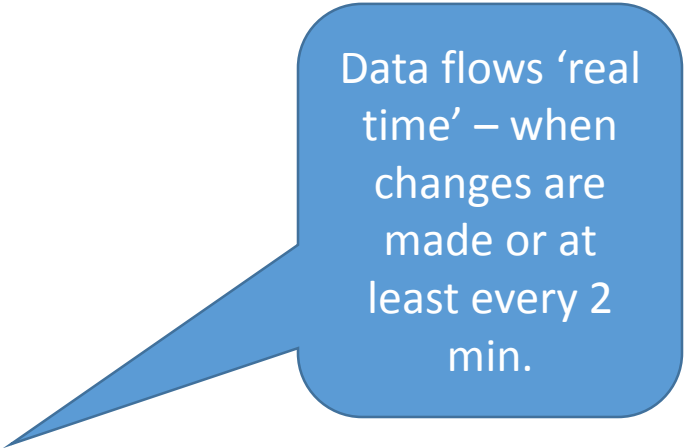


~\$3,000 per truck for  
AVL equipment  
\$7 per month per truck  
for data plan  
\$43,000/year for data  
hosting



# Data Collected

- Truck location
- Speed
- Heading
- Front and wing plow up/down
- Spreader data
  - Set rate
  - Instantaneous rate
  - Material type
  - Prewet/antiice rate
  - Cumulative 'storm totals' of applied materials
- Odometer (sometimes)
- Pavement and air temperature



Data flows 'real time' – when changes are made or at least every 2 min.

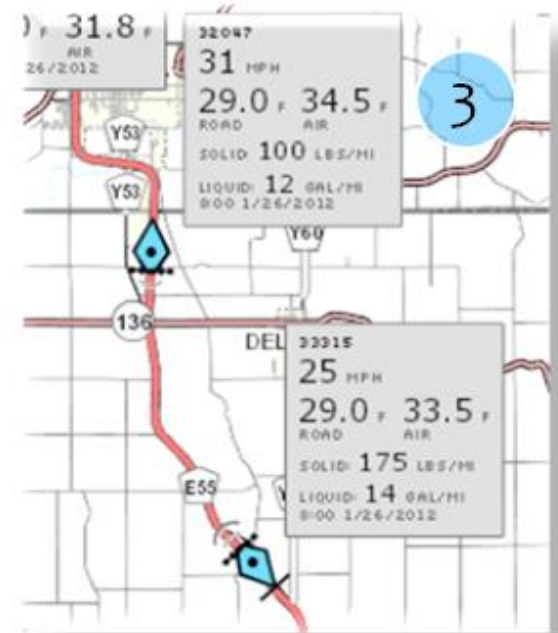
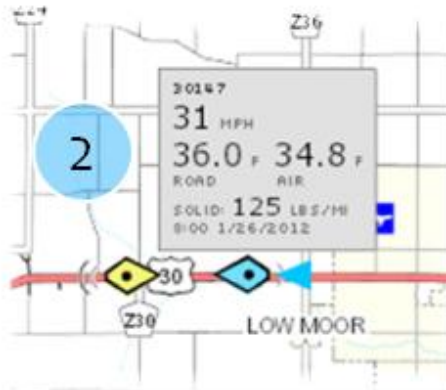
Print Map	Reports	Export Map	View Results	View Selected	Point	Polygon	Circle	Text	Edit Drawing
Printing	Reports	Export Tools	Results						
					Freehand	Rectangle	Ellipse		Erase Drawing
					Line	Arrow	Triangle		Clear all drawings

Drawing Tools

Map Layers

- Operational Layers
  - Winter Tweets (TEST)
  - RWIS
  - AWOS Live
  - CARS 511 - IA
  - Winter Reports
    - Current Totals
      - Last 1 Hour
        - Liquid\_1hr
        - Solid\_1hr
        - Prewet\_1hr
      - Last 3 Hours
      - Last 6 Hours
        - Liquid\_6hr
        - Solid\_6hr
        - Prewet\_6hr
      - Last 12 Hours
      - Last 24 Hours
      - Last 48 Hours
      - Last Week
      - Last 30 Days
      - Winter Totals
      - Winter Totals 2011
    - Traffic/ATR
    - Trucks
      - Small Icons
      - Active Trucks
      - Truck Labels





# Iowa DOT Snowplows

Map shows Iowa Department of Transportation's snowplows.



**Snowplow**

<b>Reported</b>	01/09/2014 08:26:54 AM
<b>Direction</b>	West
<b>Air Temp</b>	11
<b>Road Temp</b>	4
<b>Solid Material Rate</b>	0
<b>Liquid Material Rate</b>	39
<b>Prewet Rate</b>	0
<b>Active Plows</b>	37

[Zoom to](#)



Map data © OpenStreetMap contributors, CC-BY-SA | IEM; Iowa State University



A map from: ejabrams

Tons Used: 149,026

10/15/2015 15 End of yesterday 15 Update

state is slightly under the expected salt use. Salt target considers storm type and duration, concurrent pavement temperatures, and traffic volume of roads impacted by

Target Salt % Of Target Used

156,803



95.0 %

Target Minus Use

7,777

Allocation % Allocation Used

181,477



82.1 %

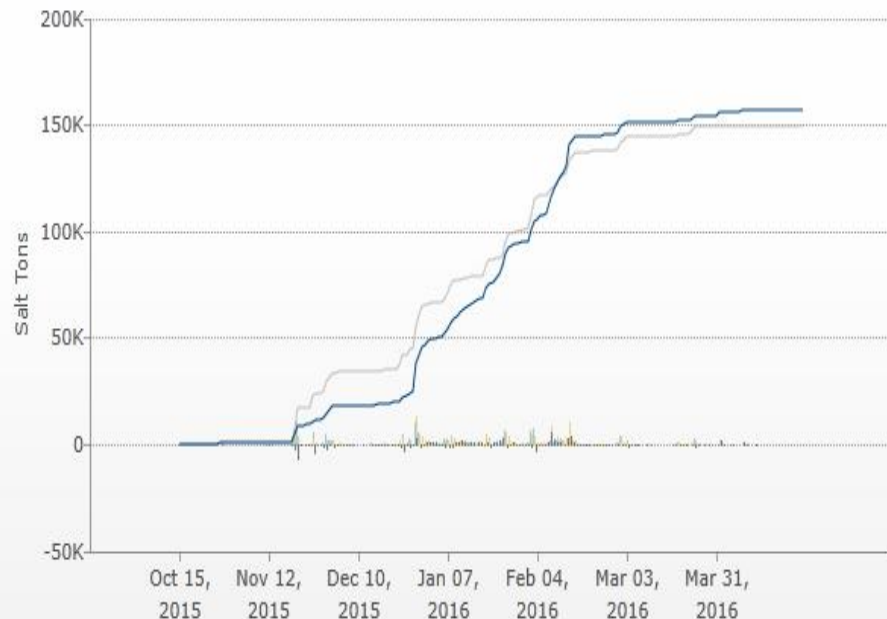
Allocation Remaining

32,451

Salt Delivery Information

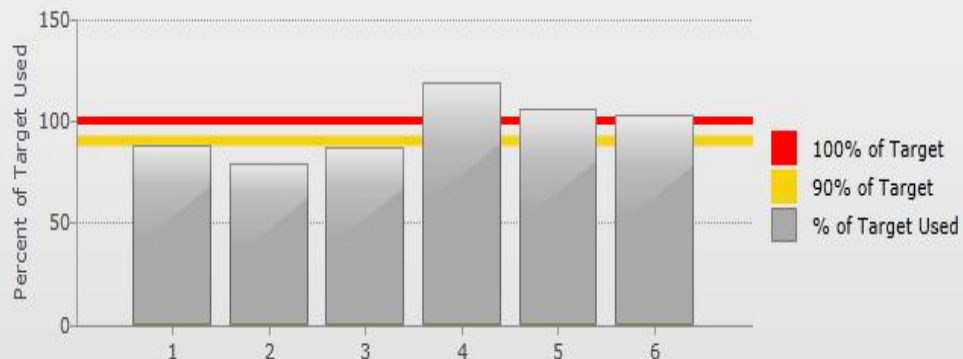
Weather Summary

Freezing Rain Hours	2,798.0
Heavy Snow Hours	4,849.5
Medium Snow Hours	10,835.7
Light Snow Hours	7,189.3
Blowing Snow Hours	13,410.5
Other Precip Hours	18,785.7

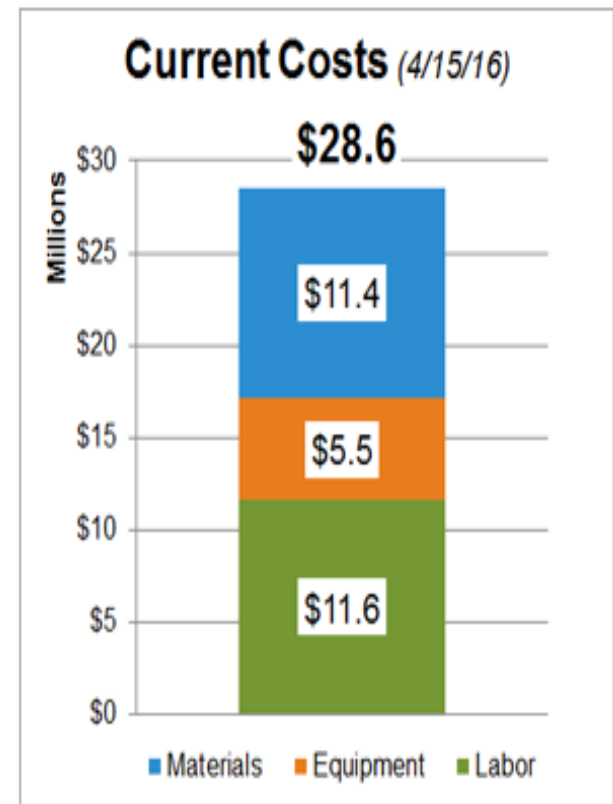
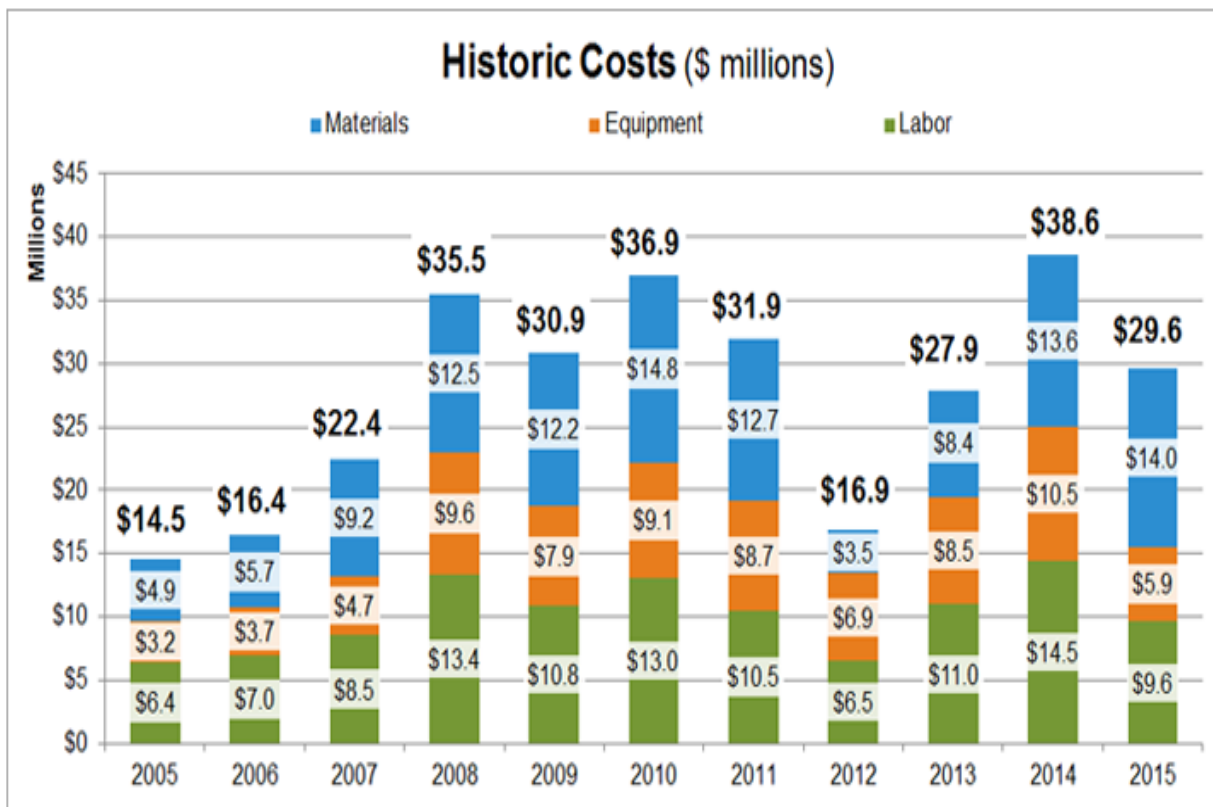


- Salt Used
- Target - Use
- Cumulative Target Salt
- Target Salt
- Cumulative Salt Used

District Summary

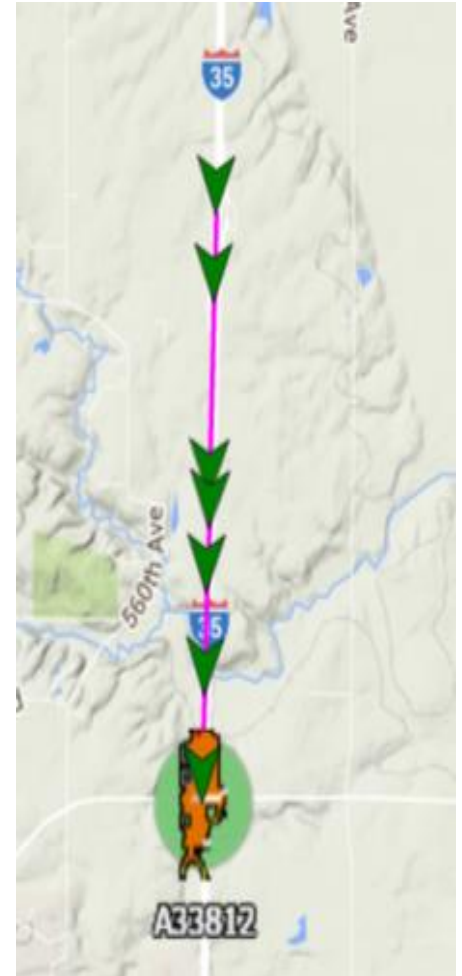


# Winter Maintenance Season Expenditures



# Plow GPS Update

- First GPS system install began in 2010
- Since 2012, all ~900 plows equipped with GPS
- New GPS system contract awarded in September to Skyhawk
- “Split” deployment to accommodate budgets and allow more install time
  - Installation started on ~ 540 plows through October-January
  - Districts 4, 1, 6, Waterloo, and new trucks
  - Remaining fleet to be equipped this spring, likely before July
  - Old contract ends June 30



# New Features

- New hosted user-interface
- More engine diagnostics
- In-truck WiFi
- More spreader system information
- US Cellular instead of Sprint

The screenshot displays a fleet management software interface. On the left, an 'Assets' sidebar lists various vehicles, with A30151 highlighted. The main area is titled 'History Report: A30151' and contains a table of data points. Below the table is a 'Report Parameters' section with date and time filters and a 'Generate Report' button. At the bottom, a map shows the vehicle's location and movement path, with a callout box for asset A30151 at 06:09:43 am CST, showing a speed of 29.9 mi/h and heading of NW (327°).

#	Date (yyyy-mm-dd hh:mm:ss)	Processed (yyyy-mm-dd hh:mm:ss)	Message	Location (* Invalid GPS Fix)	Network	Speed (mi/h)	Heading	Info
2127	2016-02-14 06:09:58 am CST	2016-02-14 06:09:58 am CST	Position	41.5428, -90.6777	CELL	33.4	NW (351°)	
2128	2016-02-14 06:09:51 am CST	2016-02-14 06:09:51 am CST	Position	41.5419, -90.6775	CELL	31.1	NW (346°)	
2129	2016-02-14 06:09:46 am CST	2016-02-14 06:09:46 am CST	Spreader	41.5413, -90.6772	CELL	29.9	NW (334°)	Spreading Solid: 264.0 lb/mi Liquid: 1.7 gal/mi
2130	2016-02-14 06:09:45 am CST	2016-02-14 06:09:45 am CST	Position	41.5412, -90.6771	CELL	29.9	NW (331°)	
2131	2016-02-14 06:09:43 am CST	2016-02-14 06:09:43 am CST	Position	41.5410, -90.6769	CELL	29.9	NW (327°)	

Report Parameters  
 Report Format: [Icons]  
 From: 2016-02-14 00:00  
 To: 2016-02-14 12:00  
 Or: Select Range  
 Generate Report

Map: Satellite  
 Asset: A30151  
 Message: Position  
 Date: 2016-02-14 06:09:43 am CST  
 Speed: 29.9 mi/h  
 Heading: NW (327°)  
 Front Plow Down

Map data ©2016 Google Terms of Use Report a map error

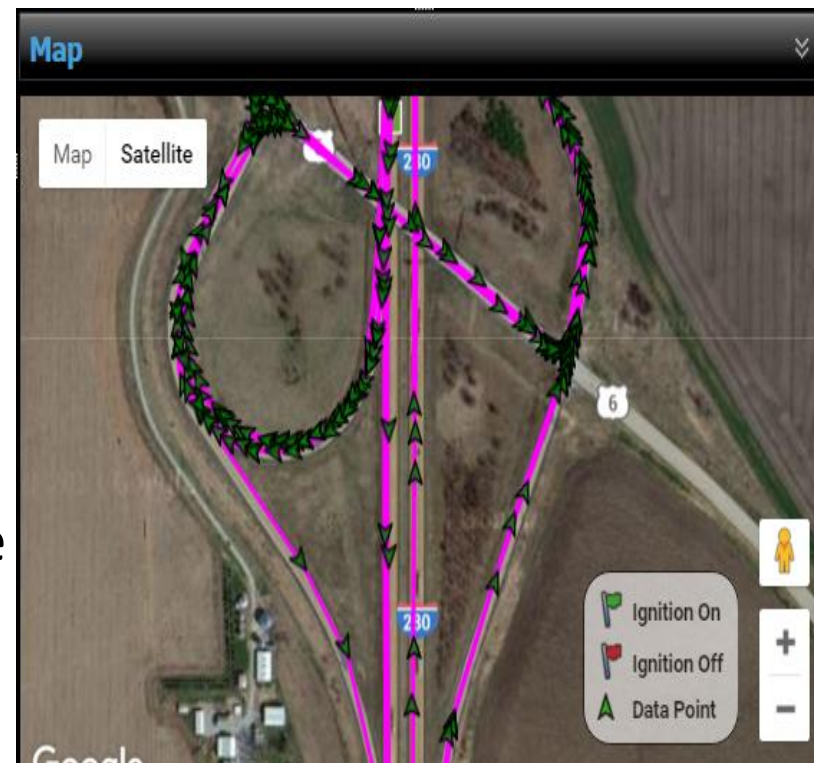


# Reporting Features

- Storm replay
- MIL alerts to email
- Real-time and historical crumbtrail
- Custom geofence setup
- Winter operations material/hours summaries by
  - Trip
  - Time
  - Geofence
- Now used by Claims Dept. for managing complaints and damage claims

From: "[no-reply@connectanywhere.co](mailto:no-reply@connectanywhere.co)" <[no-reply@connectanywhere.co](mailto:no-reply@connectanywhere.co)>  
Date: March 2, 2016 at 7:56:10 AM CST  
To: "Wolf, Ronald [DOT]" <[Ronald.Wolf@dot.iowa.gov](mailto:Ronald.Wolf@dot.iowa.gov)>  
Subject: MIL Alert: A32859

Trouble Code(s):  
SPN: 8321 FMI: 7 CM: 0 OC: 0  
Occurred: 2016-Mar-02 07:56:08 CST  
<http://goo.gl/IS1emg>



...Also in 2013-14 – The Plow Cam!



# iPhone Plow Cams

## What

- iPhones with suction-cup windshield mounts
- Custom app snaps a photo of road every 10 minutes if truck is moving

## Why

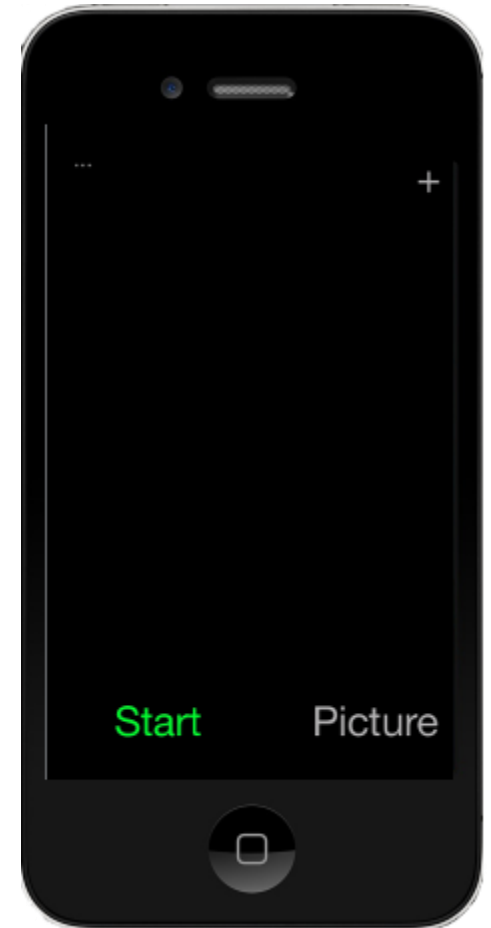
- A picture is worth a thousand words
- Road condition monitoring for managers and public

## How

- Phone sends picture and GPS coordinates to server
- Photo posted on website map with location

# Why iPhones?

- Could not just plug a regular camera into our current GPS/AVL system
- Has its own connectivity and data transfer
- Cheap (free with data plan ~\$35/mo.)
- Nice photos
- Easily available
- Can design custom programming
- Multi-functional
- Simple



1-hour of photos  
available to Internal AVL  
website

The screenshot shows a web browser window with the URL `iowadot.maps.arcgis.com/apps/webappviewer/index.html?id=3d5bc4ec8c474870a19c7e8f44b39c9c`. The page title is "Track a plow" and it includes "Winter Travel Information 511". The main content is a map of Iowa with various colored lines (blue, purple, red) representing plow routes. A popup window is open over a specific location, displaying a photo of a plow on a road. The popup text includes: "(1 of 2)", "2/2/2015, 9:44:43 AM", "I 35 N Mile Marker 42", "Edited by IowaDOT\_GIS 5 minutes ago", and a "Zoom to" button. The browser's address bar and several tabs are visible at the top.

The screenshot shows the "WOPR - Winter Operations Portal & Reports" interface. At the top, there is a search bar labeled "Search for map features...". Below it is a map showing a grid of roads and several colored markers (red, yellow, green). A popup window is open, showing a photo of a plow on a road. The popup text includes: "1/13/2014 3:15:53 PM", a photo, and a URL: `https://lectraonvise.iowadot.gov/publicavl/plowpic/`. Below the photo are buttons for "Add To Selected" and "View Additional Details". The map interface includes a scale bar (5mi, 10km) and a "I want to..." dropdown menu.

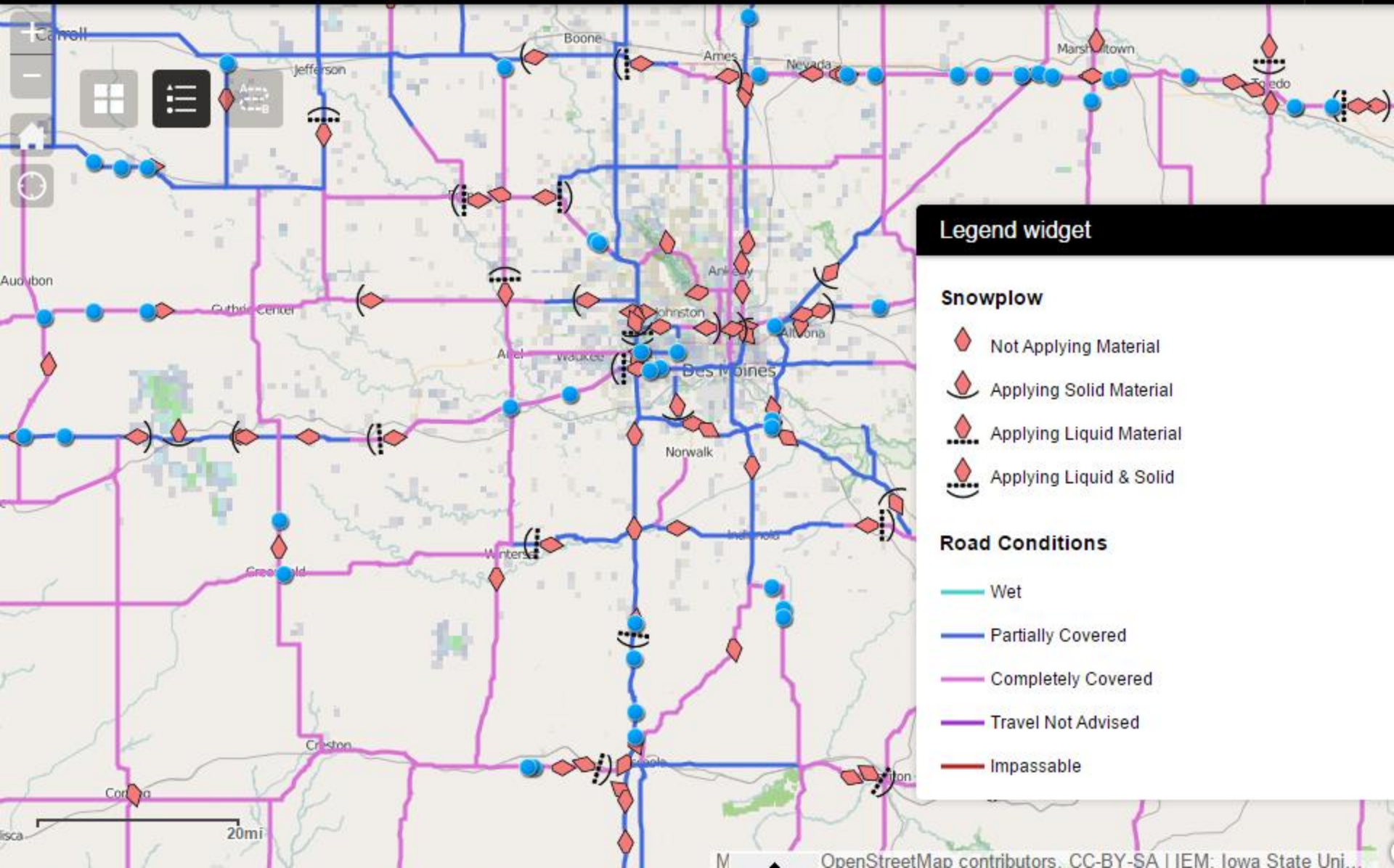
½ hour available  
to public plow  
page

# How Plow Cam Helps Maintenance

- Supervisors can check on many roads at once
- See if maintenance plan is having the intended effect
- Snoop on other regions' progress
- Watch the storm roll in and its impact before it arrives on location
- See if precipitation on radar is actually hitting the ground -- and vice versa

# 2014-2015 AVL/Plow Cam Timeline

- Public site (dubbed Track a Plow) renovated
- Expanded to ~420 plow cams
  - Currently don't believe all plows must be equipped
- IT fixed some bugs that were causing the app to crash
- PlowCam code and documentation now available to share with other agencies



### Legend widget

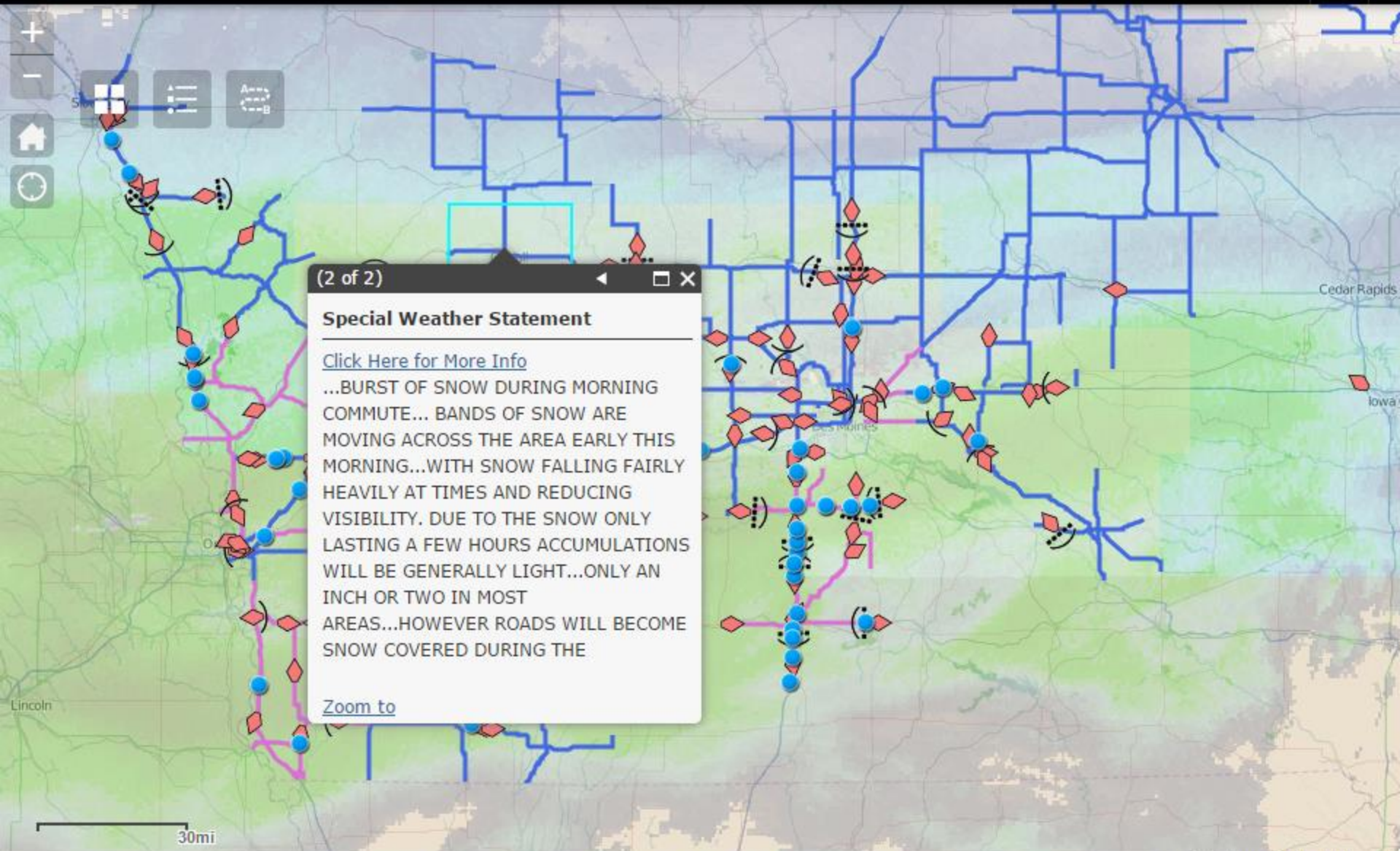
**Snowplow**

- ◊ Not Applying Material
- ◊ Applying Solid Material
- ◊ Applying Liquid Material
- ◊ Applying Liquid & Solid

**Road Conditions**

- Wet
- Partially Covered
- Completely Covered
- Travel Not Advised
- Impassable





(2 of 2)

**Special Weather Statement**

[Click Here for More Info](#)

...BURST OF SNOW DURING MORNING COMMUTE... BANDS OF SNOW ARE MOVING ACROSS THE AREA EARLY THIS MORNING...WITH SNOW FALLING FAIRLY HEAVILY AT TIMES AND REDUCING VISIBILITY. DUE TO THE SNOW ONLY LASTING A FEW HOURS ACCUMULATIONS WILL BE GENERALLY LIGHT...ONLY AN INCH OR TWO IN MOST AREAS...HOWEVER ROADS WILL BECOME SNOW COVERED DURING THE

[Zoom to](#)

Public  
Response:  
Extremely  
positive!



Like · Comment · Share · 5 1 3

5 people like this.

3 shares

**Travis Edrington** Are there any other state DOTs as awesome as this one?  
Like · Reply · 2 · 3 hrs



**Nina Friese** @friisey · 3h  
**@iowadot** Will do; I'm copilot today.



[View conversation](#)



**Kurt Beyer** @beyerku · 3h  
One of my favorite things about the Iowa DOT: Live snowplow tracking and live snapshots from the plows [trackaplow.iowadot.gov](http://trackaplow.iowadot.gov) **#awesomesauce**



**Iowa DOT** @iowadot · 3h  
**@friisey** Sorry, but this dry snow blows around and it's just going to get worse as the day goes on. Please be safe.

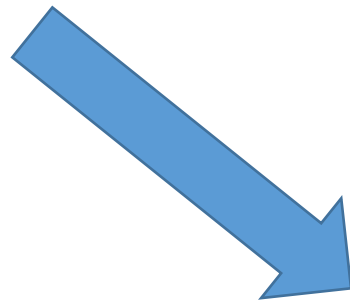
# Involving the Public

- Communications staff used images and plow counts extensively
  - Multiple posts per day
  - Before, during, and after storms
- Fewer calls from public and law enforcement “wondering if we were out”

The image shows a screenshot of a Twitter thread. The top tweet is from Heather Nell (@poondesatini) and says: "We have 423 snowplows on IA roads. Track the plows and view images taken from the dashboard @ trackaplow.iowadot.gov". Below the text is a map of Iowa with a grid of roads. Blue dots represent snowplows, and red diamond shapes represent cameras. The map shows a dense network of roads across the state. Below the map are interaction icons: a reply icon, a retweet icon with the number '1', a star icon with the number '1', and a menu icon. To the right of these icons is a red "Expand" link. The second tweet is from Karen (@karenl\_m) and says: "@iowadot Wow! What a cool feature". Below her text are interaction icons: a reply icon, a retweet icon, a star icon, a menu icon, and a red "View conversation" link. The third tweet is from Rusty Dawkins (@rustywx) and says: "Absolutely love this. See where the snowplows are in Iowa, click on blue to see their view! iowadot.maps.arcgis.com/apps/webappvie... H/T @ChrisKuball". Below his text are interaction icons: a reply icon, a retweet icon with the number '2', a star icon with the number '1', and a menu icon. The fourth tweet is from Statewide Iowa 511 (@statewideia511) and says: "We have 423 snowplows on IA roads. Track the plows and view images taken from the dashboard @ trackaplow.iowadot.gov". Below the text is a partial view of the same map from the first tweet.

# Involving the Public

- ~500,000 photo/info requests per day in some large storms
- Used by TV stations for their news/weather segments



**Heather Nell** @poondesatini · 6m  
We have 423 snowplows on IA roads. Track the plows and view images taken from the dashboard @ [trackaplow.iowadot.gov](#)



1

**Karen** @karenl\_m · 9m  
[@iowadot](#) Wow! What a cool feature

**Rusty Dawkins** @rustywx · 11m  
Absolutely love this. See where the snowplows are in Iowa, click on blue to see their view! [iowadot.maps.arcgis.com/apps/webappviewer](#) H/T [@ChrisKuball](#)

2

**Statewide Iowa 511** @statewideia511 · 19m  
We have 423 snowplows on IA roads. Track the plows and view images taken from the dashboard @ [trackaplow.iowadot.gov](#)



# What We Have is a Good Start But...

- We need more engine data
- Cell coverage gaps/data drops are problematic
- Need different data at different frequency to support Resource Management System
- Seems silly having 2 cell systems (one for AVL, one for plow cam) in the truck
- Need easier/deeper automated reporting capabilities
- Our plow sensors are not accurate

# Potential Solution?

- We need more engine data
- Cell coverage gaps/data drops are problematic
- Need different data at different frequency to support Resource Management System
- Seems silly having 2 cell systems (one for AVL, one for plow cam) in the truck
- Need easier/deeper automated reporting capabilities
- Our plow sensors are not accurate

Looking for alternate  
(maybe Bluetooth?) plow  
blade sensors

Looking into new AVL  
system

# Looking to the Future

- Vendor-hosted analytics/website
  - Many automated reports and visualization tools for summarizing plow data
  - More historical play-backs
- Engine fault alerts and idle reports
- External feed to support public pages and DOT analysis
- Internet connectivity to support plow cam and other?
- More frequent spreader data
- Better cell coverage

# Looking to the Future

- Started a trial of a new system on 10 trucks which had previously experienced data connectivity problems





# What We Learned

- It is much easier to collect data than it is to provide good information
  - Had to learn the hard way what data we *really* need – and for what purpose
  - Still working on good reporting systems
  - Must try to fill gaps or summaries won't be accurate
- Plow photos are much more useful than we thought at first
- Careful and proactive communication with public seems to really help
  - How much to communicate is always under debate!
- It is an iterative process



# Thanks! Any Questions?

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