Winter Maintenance
Direct Liquid Application (DLA)

State & County Highway Winter Maintenance

Jefferson County Highway Department (WI)

June 6, 2023

DLA Methods

Jefferson County Highway Department

[Located between Madison & Milwaukee, WI]

- 540 Lane Miles of State/Federal Highways

[4-lane Hwys: Interstate 94, State Highway 26]

- 525 Lane Miles of County Highways
- 24-Hour Service & 18-Hour Service for Winter

DLA Methods

Jefferson County Highway Department [13 years]

- *Pre-2010 – Very limited liquid use (Bridge decks)*
- 2010 to 2014 – Pre-Wet Tanks to all Primary Plow Trucks
- 2015 to 2016 – High Capacity Brine Maker with New Facility, Higher Volume Anti-Icing
- 2017 'All Brine' Plow Route – Pilot Route, Tank Insert
- 2017-18 Multiple DLA Pilots - Move County Toward DLA on all Plow Routes (Tanker trucks)
  - 2018-2023 All Primary Plow Routes with Large Liquid Tanks

DLA Methods

Pre-Wetting Salt is not DLA!!

- Salt Brine applied to auger, spinner, or salt in box
- Direct Liquid Application (DLA) only includes salt brine directly applied to pavement

PHASE I – Liquid Use

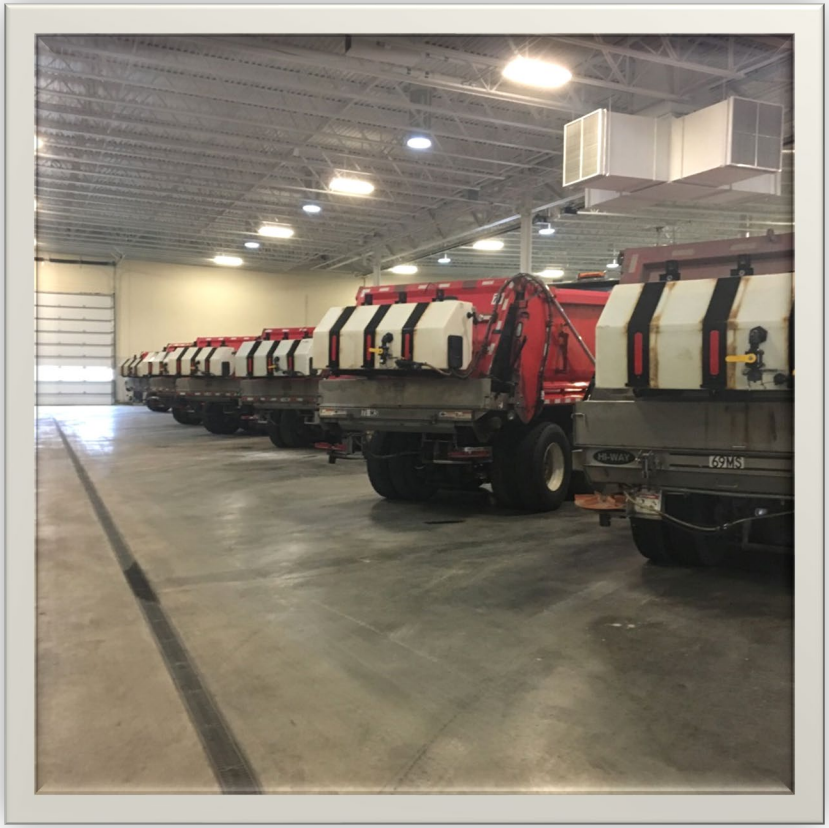
2010 to 2014

{Pre-Wet, Bridge Deck Phase}

Tri-Axle Plow Fleet
[Pre-Wet]

- Fourteen (14) Tri-Axle trucks equipped with 200 gallon Pre-wet Tanks

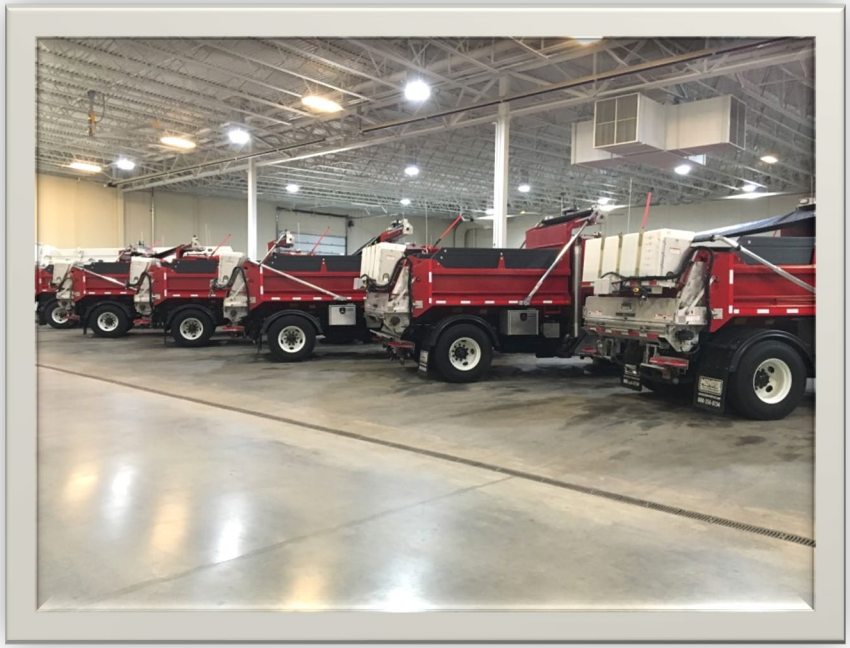
Not DLA!



Single Axle Plow Fleet [Pre-Wet]

- Eight (8) Single-Axle Trucks with 150 Gallon Pre-wet tanks for Primary Routes

Not DLA!



DLA Methods

Direct Liquid Application (DLA)

- **Pre-Storm** ***(Anti-Icing) – Common Technique***
- During Storm
- Post-Storm

DLA Methods

DLA - Pre-Storm (Anti-Icing)

- Salt Brine application before the storm
- On schedule or based on weather forecasts
- Bridge Decks, Curves, Shade, or Long Line
  - History of frosting/log locations
- Equipment Use – Truck with Spray Bar
- Application Rates – 20 to 40 gallons per lane mile

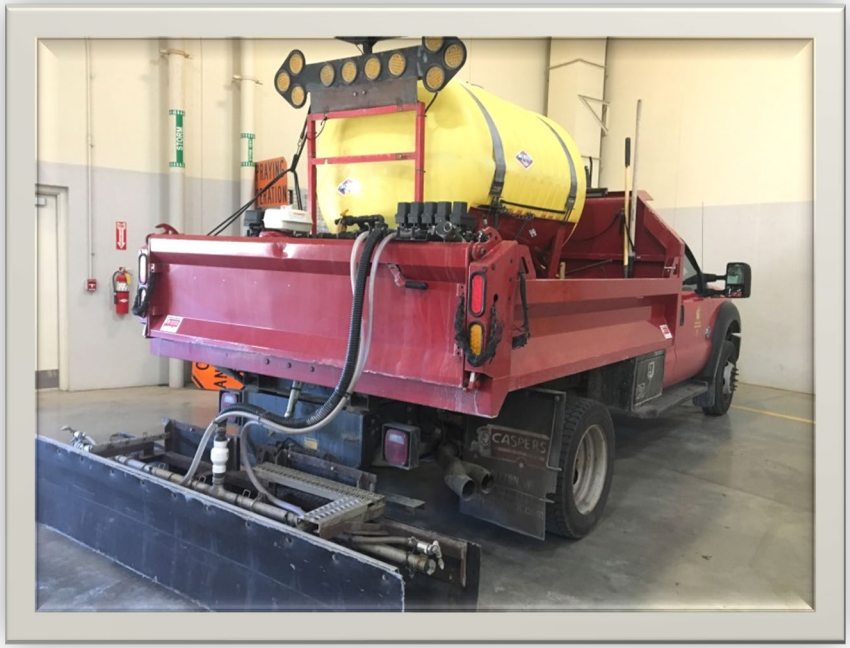
DLA Methods

DLA Equipment Options

- **Tankers, Trucks with Tanks** (No plow equipment)
- **Plow Trucks** *(Inserts)*
  - **Winter Body/Insert(s)**

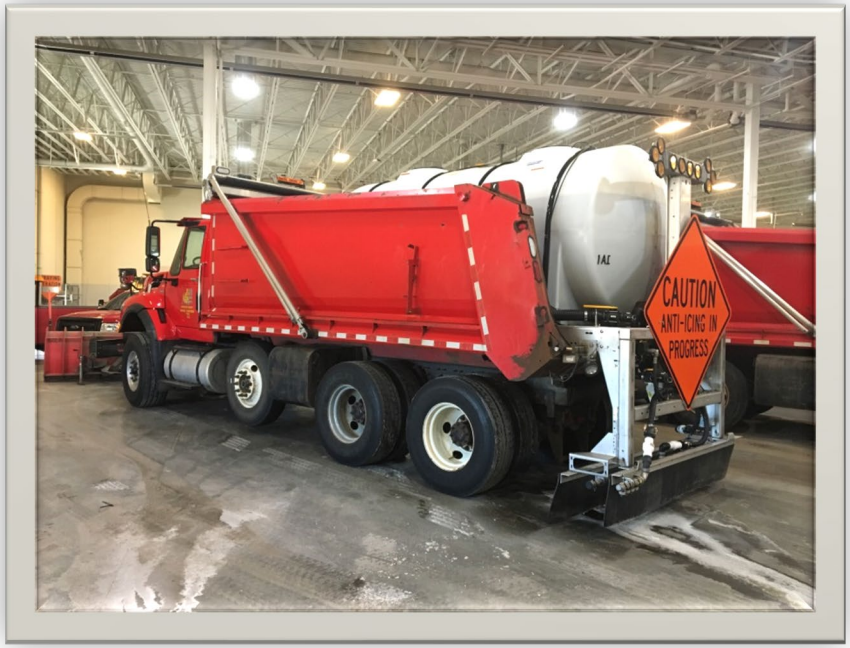
‘Pre-Storm’ Bridge Deck [Anti-Icing]

- 500 Gallons used for Anti-Icing bridge decks for Frost
- Low Cost conversion



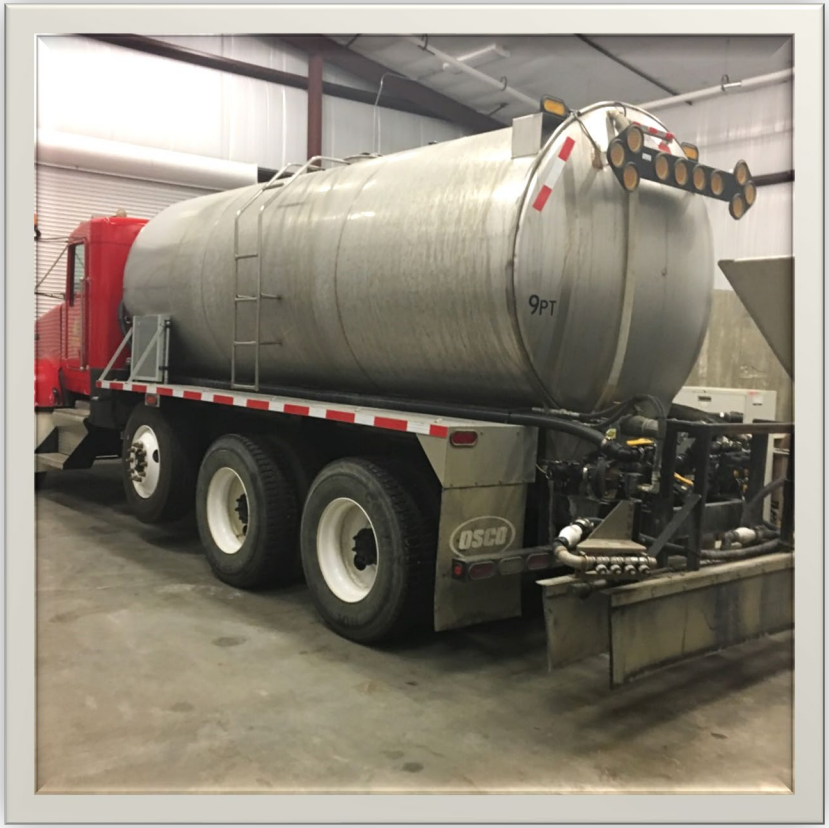
‘Pre-Storm’ [Anti-Icing]: Bridge Decks/Long Lining

- Bridge Decks
- Highway Shade Areas
- Highway Curves
- 1,800 gallons of brine



‘Pre-Storm’ [Anti-Icing]: Bridge Decks/Long Lining

- Bridge Decks
- Highway Shade Areas
- Highway Curves
- 3,000 gallons brine



DLA (Advanced) Methods

Advanced DLA Techniques

- **Direct Liquid use During Storm Event**
- **Direct Liquid use After Storm Event**

**** Note: Be Cautious***

- Back-Up Methods/Route Overlaps
- Route Selection & Length [Short Sections]
- Start Small and Gain Confidence

PHASE II – Pilot Work

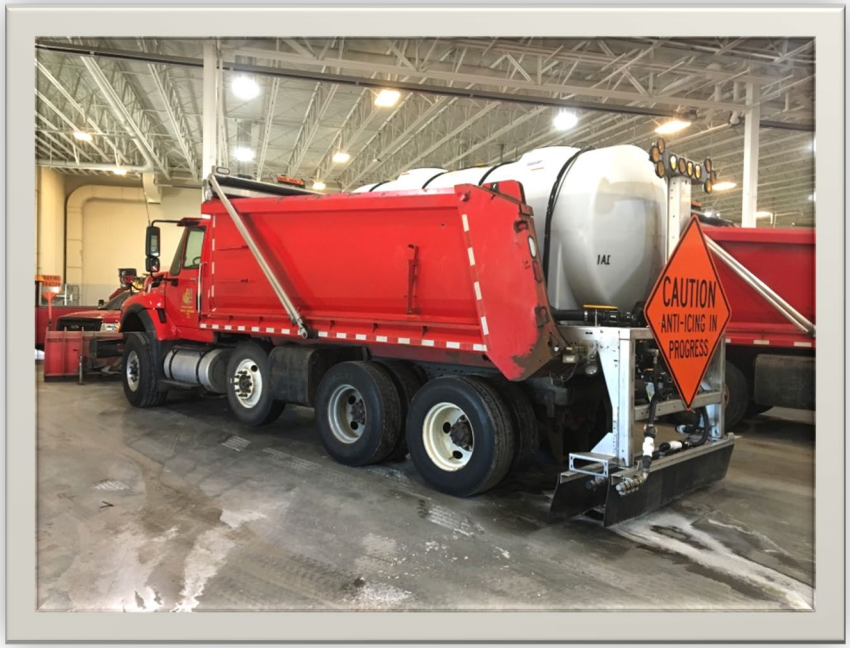
2016 to 2018

{DLA Pilot Phase}

Year 1 – DLA PILOT

‘Liquid Only’ Plow Route

- **Pilot for 2017-18 Winter**
- County plow section near main shop
- 22 lane miles (Short)
- 1,800 gallons of salt brine
  - Now used on a state section



DLA Methods

Pilot Section Data (2017-18)

* Tri-Axle Truck with Plow, Wing, 1800 gallon tank insert
* County Section 22 lane miles (Short)
* Test: Spray nozzles, application rates, centerline option spray bar
* Used only liquids for entire winter (31 storms)
* ***Positives:*** 45% less salt, quicker reaction, best with small/dry snow events
* ***Negatives:*** Higher moisture events, higher snow pack, can re-freeze quicker

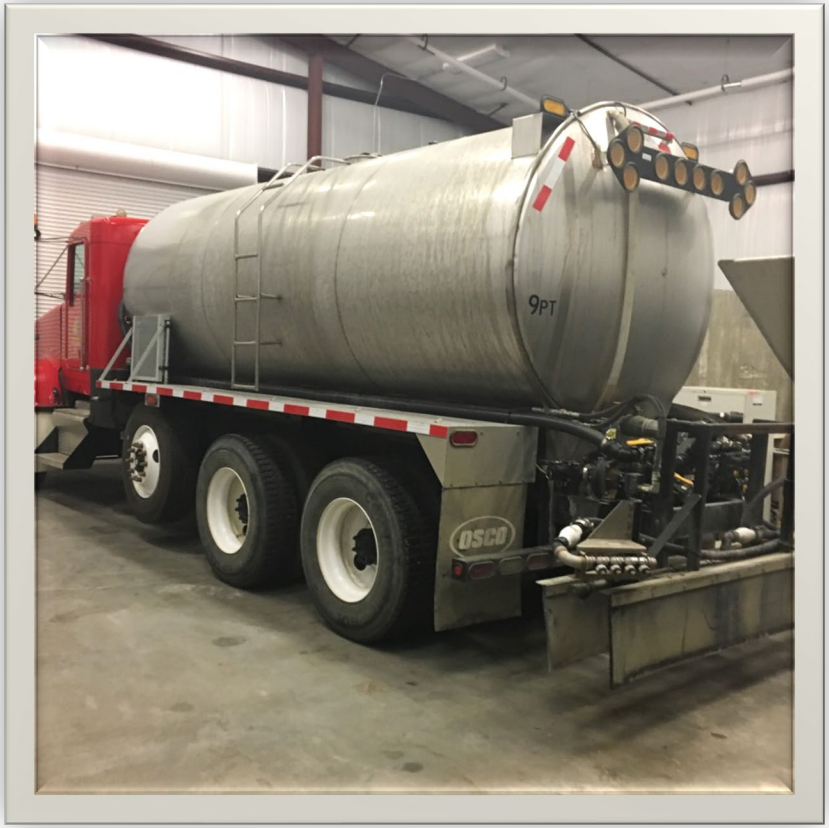
Overall Summary: Move to combination trucks with high liquid capacity (DLA) and dry rock salt capacity

Year 2 – DLA PILOT

Direct Liquid Pilot

STH 26 (South)

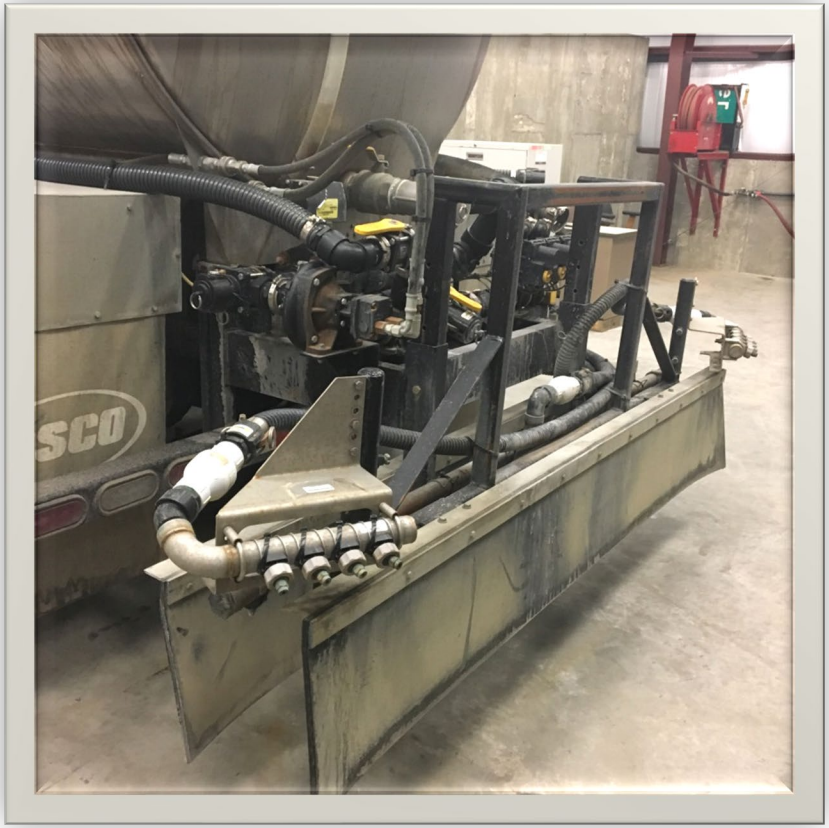
- **Pilot for 2018-19 Winter**
- 79 lane miles (4-lane, 70mph)
- 3,000 gallons of salt brine
  - Now used to supplement plow routes for post storm clean-up



Direct Liquid Pilot
STH 26 (South)

Spray Bar Options:

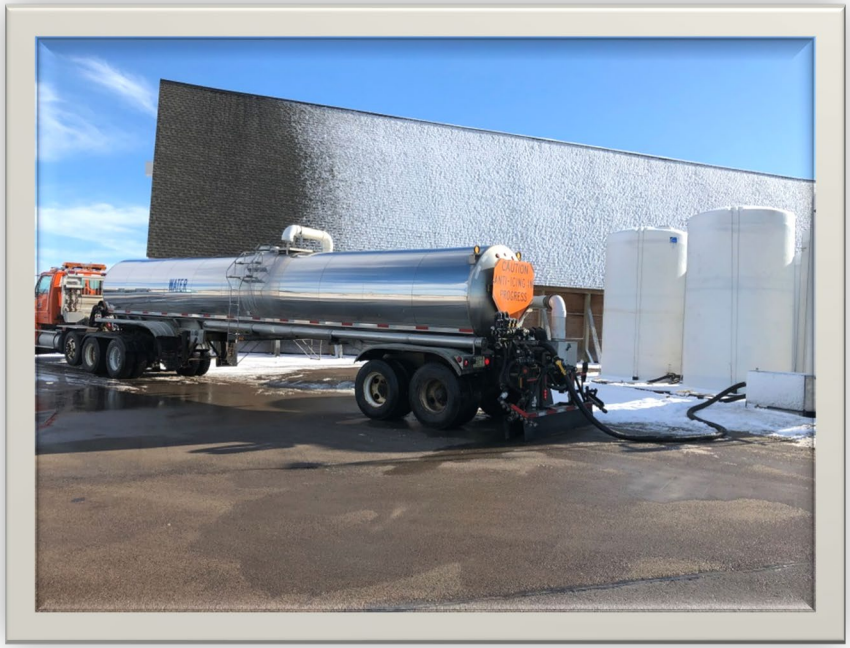
- Full Lane
- Turning Lanes
- Centerline (short bar)
- High Pressure



Year 2 – DLA PILOT

DLA Tanker (6,200 gal)

- **Pilot for 2018-19 Winter on Interstate 94 (4-lane, 70mph)**
- Supplement for two plows
- Coverage for 100 lane miles
  - Now used to supplement plow routes for post-storm clean-up



PHASE III – DLA Routes

2018 to 2023

{DLA Implementation - Routes}

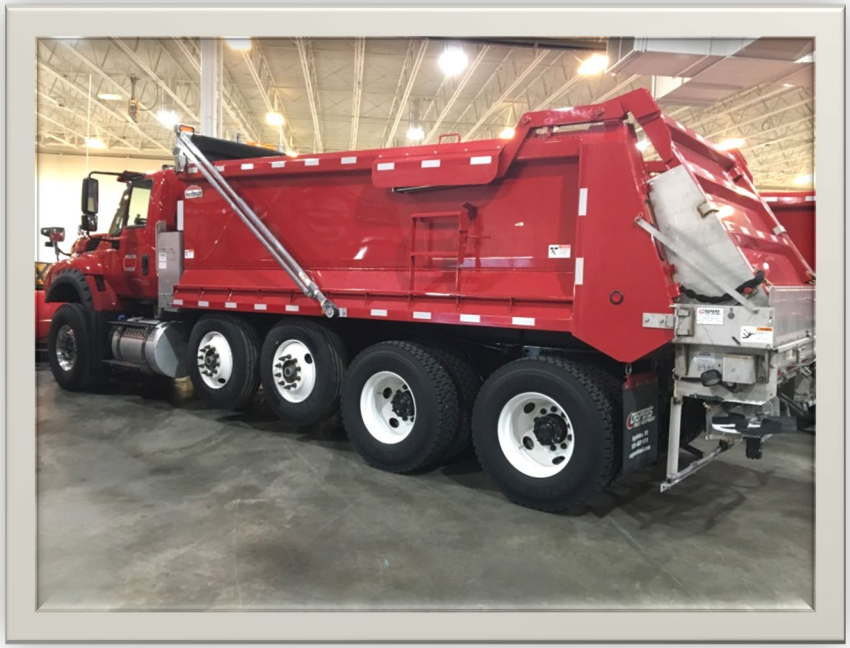
DLA Methods

DLA Plow Routes (22 Routes)

* Plow Route Drivers access to use of Rock Salt and Liquid Brine with DLA abilities
* Ability to use rock salt only, salt brine only, or a combination of rock salt and salt brine
* Capable of mixing additives into brine for cold temperatures
* Capable of mixing rust inhibitors into brine for less corrosive winter material applications

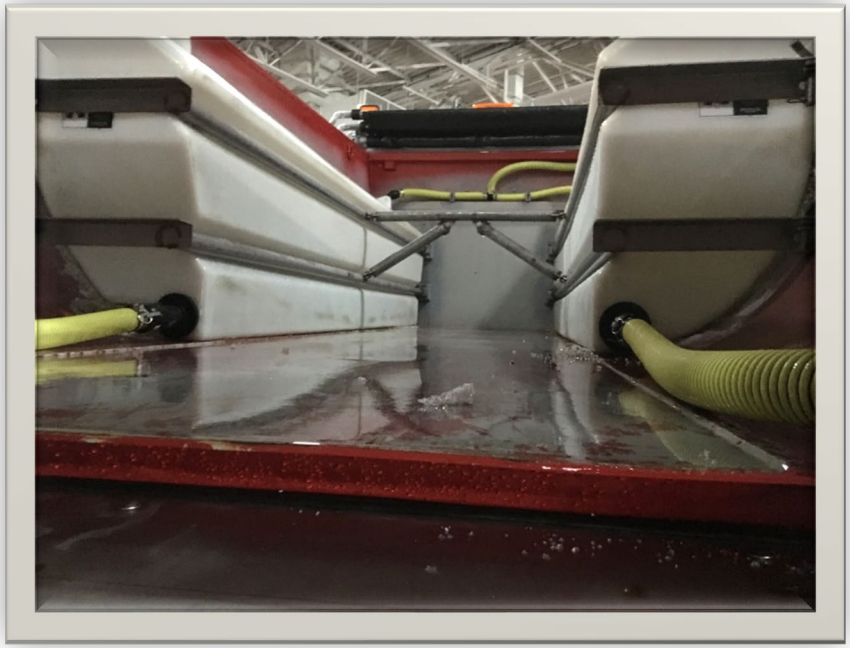
Year 3 – Routes
Quad-Axle Plow Truck (DLA)

- 1,500 Gallons of Salt Brine Capacity, Rock Salt
- Spray bar with Direct Liquid Application (DLA)



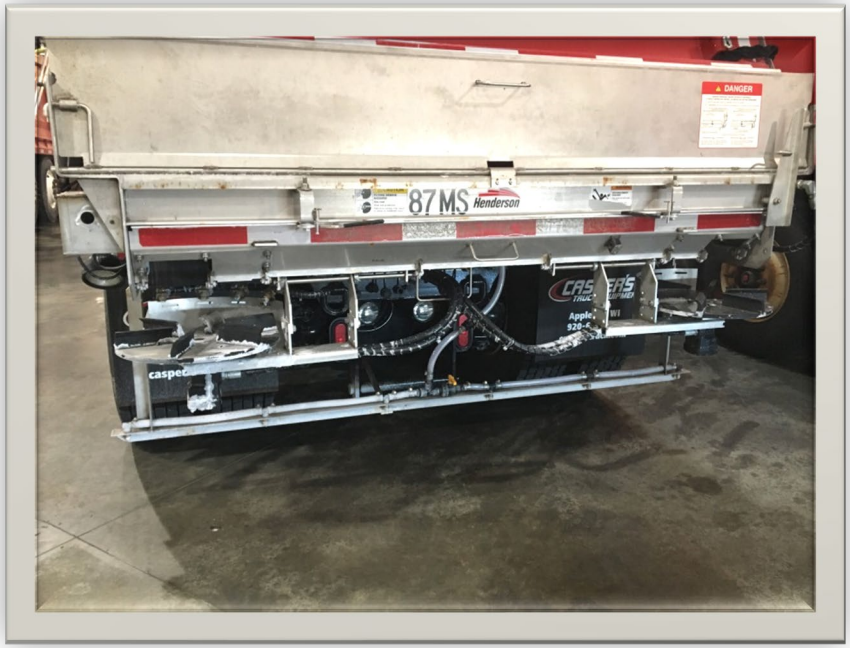
Quad-Axle Plow Truck (DLA)

- Dual 750 Gallon Tanks
- Converted to Dual 750 Gallon Tanks in 2019
- Direct Application of either liquid or dry salt or combination



Quad-Axle DLA Spray Bar

- Trucks can spray on full-lane or just centerline (short bar)
- Trucks have 1500 gallons of liquid capacity
  - Trucks have capacity for 9 tons of rock salt



DLA Methods

DLA - During Storm

- Apply only as-needed based on policy and storm conditions
- Pay close attention to storm and weather data/forecasts
  (Storm Start/Stop, Pvt Temps, Winds, Humidity, etc.)
- Need well-trained plow drivers and supervisors and excellent communication
  - Equipment Use – Plow Truck with Spray Bar or stand-alone tanker truck *[Note: Tank size may limit rates used]*
- Application Rates – 25 to 75 gallons per lane mile
- *Technique: Centerline application with short Spray Bar*

DLA Methods

DLA - Post Storm (Clean-up)

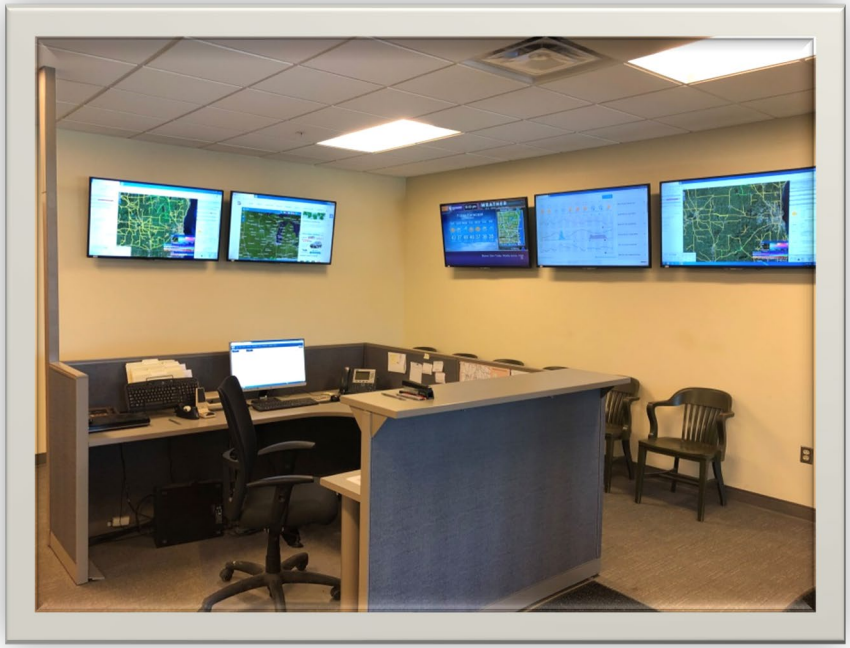
- Use liquid-only or in combination with rock salt based on hardpack and highway condition
- With more hardpack, work to open from centerline first – liquid on short bar
- Need well-trained plow drivers and supervisors and excellent communication
  - Equipment Use – Plow Truck with Spray Bar or stand-alone tanker truck *[Note: Tank size may limit rates used]*
- Application Rates – 25 to 75 gallons per lane mile based on hardpack and weather conditions
- *Technique: Centerline application with short Spray Bar*

Salt Brine Facility (New in 2015)

- To use DLA across fleet need to make a high volume of brine and have plenty of storage
- High Capacity Salt Brine Equipment (4,000 gal/hr)
- Six Storage Tanks expanded recently to twelve tanks (72,000 gallons, 150,000 gallons total)
- Three fill points with one high volume fill point
- Producing 1 to 2 million gallons of salt brine over the last four winters

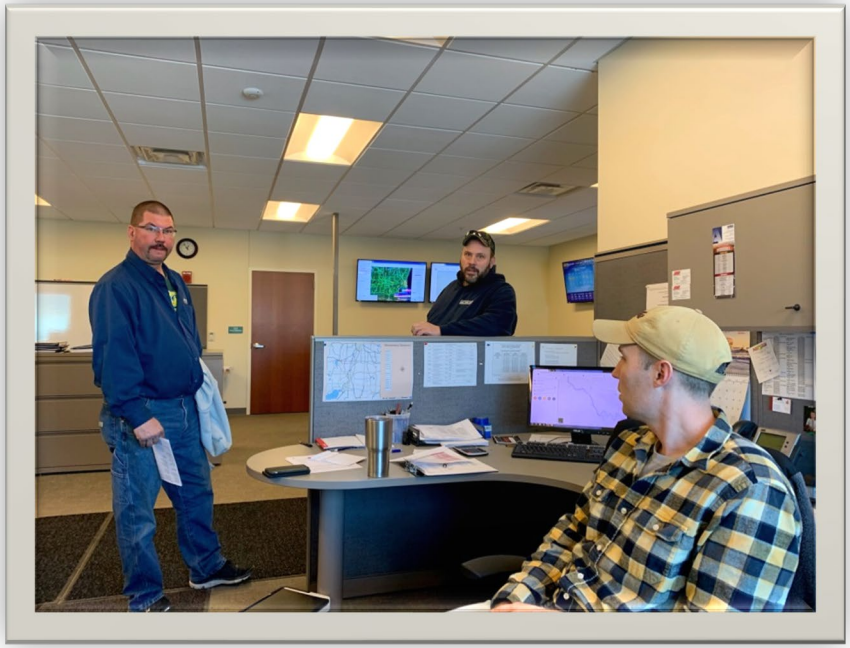
DLA Methods [Technology]

- Weather Information/MDSS
- Plow Information/AVL/GIS
- Traffic Cameras
- In-Cab Technology
  - Friction Readings



DLA Methods [Employees]

- If management, supervision, and plow drivers are not working together – DLA will fail!
- Communication/Interaction
- Annual Training
- Calibration
- Daily Storm/Data Discussions



DLA Methods

Summary

* Liquid use can reduce overall rock salt use, DLA is another tool for plow route drivers
* May reduce rock salt application rates for many storms (100 lbs per lane mile vs 300 lbs per lane mile)
* May use only liquid with DLA for smaller storm events
* 2017/2018 Pilot Salt Savings near 45% (Short section)
* 2019/2023 DLA Routes – Over 60% salt and winter maintenance savings based on severity index

Summary of Last 4 Winters [2018-2023]

* ***THE RESULTS…. …***
* Salt: A 60% reduction in salt use over the last four winters on State and County Highways (Normalized for storm severity)
* Average combined salt use combined on state and county highways over the last four winters has been 5,100 tons. In previous 10 winters the average salt use was 15,100 tons
* Average salt use per lane mile dropped on state highways over last 4 winters to 5.7 tons per lane mile, previous 12 winters the average salt use was 19.1 tons per lane mile
* Applying 20% to 25% of salt in liquid form
* Studies have shown an improved Level of Service (LOS) and quicker times to bare pavement

2018-2023 Winter Savings

* **Winter Material Summary [Salt Savings – Last 4 Winters]**

* **State Highways:** → Salt Use Expected Based on Severity Index = 33,812 tons
  Actual Salt Use = 12,589 tons
  → Salt Savings (State) = 33,812 tons – 12,589 tons = **21,223 tons**
  → Cost Savings (State) = 21,223 tons x $81/ton = $1,719,000

* **County Highways:** → Salt Use Expected Based on Severity Index = 18,150 tons
  Actual Salt Use = 8,280 tons
  → Salt Savings (County) = 18,150 tons – 8,280 tons = **9,870 tons**
  → Cost Savings (County) = 9,870 tons x $81/ton = $799,470

* **Total Cost Savings: $2,518,000 [60% Salt Reduction]**

* **Environmental Benefits:** 31,000 tons or 62,000,000 pounds less rock salt entering the groundwater, lakes, rivers and streams in Jefferson County!

Jefferson County, WI Historical Photo

I think I can hear them saying,

'If we just had salt brine, we would not be in this mess'

DLA Methods

* **THANK YOU!**

Greg Koeppel
Highway Superintendent
Jefferson County Highway Department (Wisconsin)